JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. 36 NOVEMBER 15, 1946 No. 11

PHYSICS.—*Fahrenheit and Roemer.*[1] N. ERNEST DORSEY, National Bureau of Standards.

In 1910, Kirstine Meyer (*1*) announced the finding in Copenhagen of a notebook of Ole (or Olaf) Christensen Roemer, the noted Danish astronomer. Its title is *Adversaria*, and it contains entries concerning thermometers, of which Roemer made several for his own use. She was especially impressed by the fact that he used the number 7½ to denote the ice-point, and that the same number, or an integral multiple of it, was similarly used by Fahrenheit for certain of his earlier thermometers. She was right in inferring that such an occurrence of this fractional number indicated an attempt to correlate the scales used by the two men. But, being unduly anxious to add to Roemer's already most enviable reputation, she bent every effort to convince the reader that it was from Roemer that Fahrenheit obtained everything that was needed for designing his celebrated thermometers, and even that Roemer was the first to realize the advantage of basing a thermometer scale on two fiducial temperatures, each determined by a natural phenomenon. She misread the evidence and reached false conclusions.

Those conclusions were repeated and amplified in 1913 (*2*) and again in 1937 (*3*). To the last, J. N. Friend (*4*) replied, criticizing it rather mildly. They have reappeared, summarized in a single paragraph, in a booklet issued late in 1944 by I. Bernard Cohen (*5*), who seems to have approved of them.

The persistence of these errors for more than three decades seems to call for a study of the evidence on which they rest and an exposition of their erroneous nature. Such is the prime purpose of this article. Incidentally, there are offered certain suggestions, more plausible than those of Meyer, regarding Fahrenheit's indebtedness to Roemer, and new suggestions regarding the nature and the origin of the change Fahrenheit made in his scale in 1717. And finally the Cohen summary of 1944 (*5*) of Meyer's conclusions is quoted *in extenso*, for comparison with the corresponding, but in part quite different, conclusions reached in this study.

It seems well, however, to consider at once the last sentence of Cohen's summary, expressing Meyer's ultimate conclusion as to the indebtedness of Fahrenheit to Roemer. That sentence is this: "Thus it is quite clear that it was Roemer who invented the modern thermometer and that the Fahrenheit thermometer should, in all fairness, be called the Roemer thermometer!"

Whatever the debt that Fahrenheit may have owed to Roemer, the last assertion in that sentence can not be accepted, for the very simple reason that Roemer did not publish any of his ideas about thermometers or any account of his work either with or upon them, nor did he, so far as we now know, do anything to make his thermometers generally available to scientific men. He made the thermometers for his own personal use. All that we know about them has come to light within the past 36 years, after two centuries of oblivion. On the other hand, Fahrenheit produced a superior thermometer, improved its construction from time to time, readjusted his scale in 1717 so that it would accord more accurate-

[1] Received September 11, 1946.

ly with its nominal fiducial points, distributed his thermometers widely, and published brief descriptions of their graduation and use. His thermometers became highly valued throughout the scientific world. To him belongs the credit.

It is not a question of who first had the idea or first made the instrument, but of who first made the idea or instrument available to the scientific world. No one can know how many may have had the same idea or made the same type of instrument, but kept it all to themselves, perhaps recording the idea or method of construction in personal memoranda that may some day be brought to the notice of the world. The bringing of such memoranda to notice is of great value for the light they throw on the activities of the man but is valueless for establishing his claim for priority over one who actually gave the idea or instrument to the world.

Meyer's earlier statements regarding Fahrenheit and Roemer rested almost exclusively on Roemer's *Adversaria*, which was published in 1910 by the Royal Danish Academy, as a beautiful volume of 271 pages (*6*, *17*), under the editorship of Thyra Eibe and Kirstine Meyer, and were made prior to the publication (*7*) in 1936 of Fahrenheit's letter of April 17, 1729, to Boerhaave. That letter was, however, considered in her reply to Friend (*3*).

Hence it is necessary to consider carefully both what is said in *Adversaria* regarding Roemer's thermometers and what the letter tells of the relation between the two men. But first one should recall something of the status of the science of heat at that time, and of the various practices that had already been proposed, and perhaps adopted, for defining thermometer scales. For Roemer (*5*) and Fahrenheit (*7*) were great travelers, and an important and avowed purpose of their travels was to meet men of science and to learn what was being done and thought in the world of science. At that time the construction and use of thermometers furnished a very live subject indeed, and it is inconceivable that either man should have failed to discuss it with those he met. It seems entirely fair to assume that each knew, or by his travels became acquainted with, the general state of affairs and that each made use of the information he obtained. That would be entirely proper. And no one should give to either the credit for having initiated or for having taught the other anything that was already generally known.

At the time with which we are concerned, it was very generally believed that heat was a substance that could be added to or removed from a body and that the thermometer reading gave an indication of how much heat the body contained (*8*, p. 858). Consequently, it seemed most elegant for the zero of the scale to correspond to the condition of zero heat, to the lowest possible temperature. The lowest temperature that had been observed was that produced by a mixture of snow, water, and sal ammoniac (NH_4Cl), or perhaps, sea salt: roughly 0°F. And it seems that, up to the severe winter of 1708–09, no air temperature nearly so low as that had been recorded by any thermometer. That temperature therefore became a preferred zero for thermometer scales, and some seem to have thought that it was the absolute zero—the temperature at which there is no heat in the body.[2] However that may be, quite a little excitement was caused when the temperature at Copenhagen in 1708–09 fell almost to that zero.

True, Amontons (*9*) had a different conception of heat, and he properly inferred from his air-thermometer that the absolute zero was far lower than that obtained by

[2] Muncke [*8*, p. 859+] has written: "Der strenge Winter von 1709, wobei er [Fahrenheit] sicher die Temperatur mit seinen noch unvollkommenen Thermometern mass, führte ihn auf den wichtigen Schluss, das der Punct das schmelzenden Eises nicht der eigentliche Nullpunct der Wärme sey, aber leider, glaubte er, in der damals erlebten grössten Kälte diesen Punct gefunden zu haben, und nahm ihn daher als den Anfangspunct seiner Thermometerscale." Muncke is surely wrong in thinking that the winter of 1708–09 convinced Fahrenheit that the zero of heat lay below the ice-point; for it was already known that a mixture of water-ice-NH_4Cl had a temperature much lower than the ice-point. That very low temperature seems to have been the temperature which he and many others regarded as indicating zero heat. To them the surprising thing was that in the winter of 1708–09 the air temperature came within a small fraction of a degree of that low temperature.

means of the water-ice-salt mixture. But he was ahead of his time.

Another temperature to which great importance was attached from the time of the earliest thermometers was blood-heat or body temperature. That term was believed to define a definite temperature, but it was variously understood. For example, it was taken as the temperature in the bodies of cows (*10*) and deer (*10*), the temperature of the human body (*11*), of a pullet sitting on eggs (*11*). It remained for Fahrenheit (*12*) to specify explicitly that blood-heat is to be understood as the temperature registered by a thermometer when in the mouth or armpit of a healthy man. As we know today, and as Fahrenheit may have known, even that temperature is far from constant. Did he refer to the lowest, the highest, or some intermediate temperature?

Both the ice-point and the boiling point of water were by many experimenters believed to be variable. That is not surprising. At the time, nothing was known about phase equilibrium. The ice-point was variously defined as the simple cold of snow (1657–67) (*13*), cold snow (1669, Fabri) (*14*), as the temperature at which water begins to freeze (1665, Huygens; 1701, Newton) (*15*, *11*), as that of melting snow (1701, Newton) (*11*). The boiling point was defined as the temperature of water when it is boiling, the thermometer being immersed in the water. That temperature depends not only on the atmospheric pressure, an effect that was beginning to be recognized, but also on how vigorously the water boils. Newton (*11*) reported that water begins to boil at 33° on his scale and boils vehemently at 34 to 34½—a difference of 1½ of his degrees, corresponding approximately to a difference of 8°F.

Various other natural phenomena were proposed from time to time as means for specifying fixed temperatures. But until Fahrenheit's improved thermometers became generally available, temperature measurements by different observers could not be satisfactorily compared, and consequently it was exceedingly difficult to reach a general agreement as to whether, and if so, under what conditions, the several proposed phenomena do actually specify fixed temperatures.

Two distinct, but entirely valid, principles had been proposed and used for defining a thermometer scale. One (Boyle, 1665 (*14*); Hooke, 1664 (*14*); etc.) involves the choosing of a single fiducial temperature defined by a natural phenomenon, and the choosing of a definite thermometric liquid. A numerical value is assigned to the fiducial temperature, and starting from that point a scale is so laid out that each step corresponds to a certain fixed specified fraction of the volume of the thermometric liquid when at the fiducial temperature.

The other, and older, principle (Sanctorius, 1612 (*14*); Sagredo, 1615 (*15*); the Florentine thermometers, 1657–67 (*13*); Fabri, 1669 (*14*); Newton, 1701 (*11*); etc.) involves the assigning of a value to each of two conveniently separated temperatures defined by natural phenomena, the dividing of the space between those two readings into steps of equal change in volume, and the extending of the scale beyond those fiducial temperatures, as may be desired. (In practice it was usually assumed that the tube was cylindrical, but as early as 1665 Boyle had called attention to errors arising from irregularities of the tube, and to the desirability of dividing the tube into lengths of equal volume.)

In Table 1 are given the natural phenomena defining the two fixed points of each of a number of scales that had been proposed—and mostly used—prior to 1702. (The meeting of Fahrenheit and Roemer was in 1708.) In some cases the numbering of the divisions was such as to suggest that the lower end of the scale was supposed to indicate, at least approximately, the temperature of an ice-salt mixture.

Although the definitions of these fiducial temperatures leave much to be desired, it is obvious that the principle of defining a thermometer scale in terms of two fiducial temperatures was known for upward of a century before Fahrenheit's visit to Roemer.

Turn now to Roemer's *Adversaria* (*17*), from which all we know about Roemer's thermometers seems to have been derived, and on which Meyer bases her extravagant

claims. As the title indicates, it is a notebook in which Roemer jotted down ideas, proposed procedures, preliminary computations, certain results obtained by himself or by others, curios in which he was interested, etc. For example: On 16 consecutive pages there are entries on the following subjects: Astronomical calculations (pp. 79–80); speed of travel of porters, travelers, runners, horse with load, etc. (80–83); monthly rainfall in Paris, 1689–1704 (83); astronomical notes (84–85); rate at which a horse (man) can raise water to each of certain heights (85–87); magic squares (87–94, continued from 36–42); atmospheric refraction (94). This strictly casual nature of the contents of *Adversaria* should be kept in mind in any attempt to interpret them.

Roemer's notes are in Latin, occasionally in Danish, and at various places P. Horrebow, a contemporary, has written in memoranda, sometimes, but not always, signed. It seems certain that those memoranda were inserted after Roemer's death. Some of them refer to Roemer's widow.

References to thermometers occur as follows: On pages 11–12 Roemer states that air expands by one-ninth of its volume when its temperature is increased from 8 to 18 degrees of his thermometer ("in calore meorum thermometrorum"), and that water expands by 1/200 of its volume under the same conditions. Since his 8 lay near 0°C., the ratio of these two expansions is about right; and the expansion of air indicates that each of his degrees corresponds to about 3°C.

On page 119 are recorded the observed linear expansions of 6 metal rods (Au, Cu, Ag, Sn, Pb, and Fe) for the range $6\frac{1}{2}$ to $30\frac{1}{2}$ on his thermometer. By comparing those values with the coefficients of expansion as given in the Smithsonian Physical Tables, one finds, for one of his degrees, values ranging from 1.80°C. (Fe) to 2.18°C. (Au), the average being 1.95°C., which is only 65 percent of the value derived from the data on pages 11–12.

After some pages devoted to the setting up and testing of several approximate formulas for the rapid subdivision of a conical tube into sections of equal volume, there comes on page 210 a memorandum entitled "Originale thermometrum construere" (to construct an initial thermometer; i.e., one not dependent upon another), in which are instructions for the making of such an independent thermometer that will read $7\frac{1}{2}$ in snow-and-water, and 60 in boiling water. The dependence of the latter temperature upon the vigorousness of the boiling, and its resulting indefiniteness, are not mentioned. Neither is the effect of variations in the atmospheric pressure. If one assumes that this 60 corresponds exactly to 100°C., then each degree will correspond to 1.90°C.

This is the sole reference in *Adversaria* to Roemer's 60-degree thermometer, and it should be noticed that he does not say that he ever constructed such an instrument. The verb "construere" occurring in the title is in the infinitive; the section merely tells how such an instrument might be con-

TABLE 1.—EARLY THERMOMETER SCALES BASED ON TWO FIDUCIAL POINTS

Year	Name	Lower temperature	Upper temperature	Ref.
1612	Sanctorius	Snow	Approach of candle	(14)
1615	Sagredo	Snow and salt	Snow	(14)
Prior to 1667	Florentine	Snow or ice	Midsummer sun[1]	(13)
1669	Fabri	Snow in cold weather	Direct summer sun	(14)
1670	de la Hire	Air when freezing	Deep vault	(14)
	de la Hire	Snow and salt	Solidifying tallow	(16)
1688	Dalencé	Freezing water	Melting butter	(14)
	Dalencé	Freezing water	Deep vault	(14)
1694	Renaldini	Melting ice	Boiling water	(14)
1701	Newton	Melting snow	Temp. of human body	(11)

[1] Lambert [16], on the authority of Borelli and Malpighi, has stated that the temperature in the sun on the hottest day in summer, in Florence, is the same as that in the body of a cow, a deer, etc. That is, within the then current limits of precision, the upper temperature is essentially blood-heat, and it may have been chosen for that reason.

structed. And it makes no mention of difficulties that one might expect to encounter in trying to use 100°C. as a fiducial point for an alcohol thermometer. However, it is probable that he did make at least one such thermometer.

From this section, Meyer concluded that the fiducial points defining Roemer's scale were the ice-point (marked 7½) and the boiling-point (marked 60). But, as Friend (*4*) has pointed out, it is most improbable that Roemer's lower fiducial point was the ice-point. It is almost incredible that an experienced investigator would assign a fractional number to a fiducial point. But having otherwise established his scale, it would not be at all unreasonable for him to use, for its reproduction, other temperatures defined by natural phenomena that are more convenient to use than those defining the fiducial points. Those other temperatures will in general not be represented by integral degrees on his predetermined scale. Their proper nonintegral designations must be determined experimentally, directly or otherwise. Whence one should regard the 7½ as the experimentally determined value of the ice-point on his scale; and should infer that his lower fiducial point lay 7½ of his degrees below the ice-point. That would place his zero near the temperature of a water-ice-NH_4Cl mixture, which, as has been seen, was widely held to be the most elegant starting point. That was probably the temperature which he desired his zero to represent. But whether the 7½ was directly determined by experiment, or was arrived at in another way as a mere, but satisfactory, approximation to the distance of the water-ice-NH_4Cl temperature below the ice-point, is another matter, which will be considered more fully in connection with the Fahrenheit letter.

Then, after some remarks by Horrebow, come other pages (211–213) devoted to the subdivision of conical tubes.

Page 214 is a facsimile of Roemer's plot of the daily temperatures, presumably at Copenhagen, during the severe winter of 1708–09. There is no statement about either who took the temperatures or what thermometer was used. The days are arranged in a vertical column, and the temperatures are recorded to the right in a grid completed by 9 vertical lines, each corresponding to a degree. These lines are numbered at their tops 8, 7, 6, · · · 2, 1, 0. Above those numbers, and in another hand, possibly Horrebow's, are written the same numbers in reverse order. Above them and inverted is written, Meyer says by Horrebow, the remark "mutaverat ergo Roemerus primum suum propositum," which Meyer (*1*) interprets, probably correctly, as meaning that Horrebow concluded from the numbering of those vertical lines that Roemer had changed the designation of the ice-point from 7½ to 8. Indeed, in an earlier note (p. 211) Horrebow states, apparently on the authority of this sheet, that Roemer denoted the ice-point by 8. The only ground for such a conclusion is Roemer's failure to rule a line at 7½. But why should one expect him to rule such a line? It would have merely introduced confusion in the grid. He knew where the ice-point lay—just halfway between lines 7 and 8. That remark by Horrebow seems to me to be totally unjustified; indeed, I have found nothing to indicate that Roemer ever denoted the ice-point by 8. That statement of Horrebow's was, however, fully accepted by Meyer. In fact, it was seized upon as evidence that Fahrenheit's 32 for the ice-point was taken from Roemer, being merely 4 times his 8. As will be seen presently, Fahrenheit's 8, or 32, had nothing whatever to do with the numbering of the degrees on Roemer's thermometer.

There seems to be in *Adversaria* nothing more bearing upon Roemer's thermometric work.

Whether the discrepancy between the several sizes of Roemer's degree as derived from his data for expansivities and from his instructions for constructing the 60-degree thermometer—3°C. (pp. 11–12), 1.95°C. (p. 119), 1.90°C. (60-degree thermometer)—arises from experimental errors or from discrepancies between the thermometers, is not known. No detail of the experimental work is recorded, and nothing is said about the thermometers except that they were his own. These data, however, and they are all

we have, scarcely justify Meyer's conclusion that Roemer's thermometers were superior instruments. Any such conclusion can rest only on his general reputation.

However, *Adversaria* shows beyond doubt that Roemer was well acquainted with the procedures that must be followed and the care that must be taken in the construction of thermometers if they are to be accurately reproducible. He fully realized the importance of subdividing the stem into lengths corresponding to equal volumes; he advised the rejection of tubes that are neither cylindrical nor conical, and he gave convenient methods for dividing the latter into lengths that would be sufficiently nearly of equal volumes. These approximate methods were proposed for the purpose of reducing the computational labor that is involved in an exact division.

Turn now to Fahrenheit's letter of April 17, 1729, to Boerhaave, which contains all that is known about Fahrenheit's intercourse with Roemer. That letter seems to have been written in reply to a question as to how he was led to his great improvement of the thermometer. From a German[3] translation (7) of that letter, the portions of present interest may be Englished as follows:

As for the means by which I have succeeded in the way of improving thermometers, I am most pleased to tell you that I received the first suggestion thereto in the year 1708, during a conference with the renowned Roemer in Copenhagen; for as I visited him one fine morning, I found that he had placed in a mixture of water and ice some thermometers which he later dipped again into warm water which was at blood-heat, and after he had marked these two limits on all the thermometers, he added downward from the point corresponding to the vessel of ice [and water] one half of the distance so determined, and divided the entire distance into 22½ parts, beginning with 0 at the bottom, then 7½ degrees for the point in the vessel of ice [and water], and 22½ for that at blood-heat, which division I also used until the year 1717, except that I divided each degree into four smaller parts. In this manner were divided the scales of the two thermometers that Professor Wolf reported upon in Acta Lipsinia in August, 1714. Since this division is inconvenient and inelegant on account of the fractional numbers, I decided to change the scale, and instead of 22½ or 90, to use 96, which I have done ever since, and which, although it was not so intended, I found to agree approxi-

[3] "Was nunmehr die Mittel betrifft durch welche ich auf den Weg der Verbesserung der Thermometer gelangt bin, so sei Ihnen freundlichst mitgeteilt, dass ich Ao. 1708 durch den Verkehr mit dem trefflichen Roemer in Kopenhagen dazu die erste Anregung erhalten habe, denn als ich eines schönen Morgens einmal zu ihm kam, fand ich, dass er einige Thermometer in Wasser und Eis stehen hatte, welcher er später wieder in warmes Wasser taucht, welches blutwarm war, und nachdem er diese beiden Grenzen auf sämtlichen Thermometern angegeben hatte, wurde die Hälfte des gefundenen Abstandes noch unterhalb des Punktes in dem Gefäss mit Eis zugefügt, und der ganze Abstand wurde in 22½ Teile geteilt, unten anfangend mit 0, sodann 7½ Grad für den Punkt im Gefäss mit Eis und 22½ Grad für denjeniges des blutwarmen, welche Teilung ich auch bis zum Jahre 1717 verwendet habe, nur mit dem Unterschiede, dass ich jeden Grad noch in 4 kleinere teilte. Und in dieser Weise waren auch die 2 Thermometer geteilt, über welche der Herr Professor Wolf in den Acta Lipsinia Anno 1714 mense Augusto berichtet. Da diese Teilung wegen der gebrochenen Zahlen unbequem und nicht angenehm ist, beschloss ich die Skala zu ändern und statt 22½ oder 90, 96 zu verwenden, deren ich mich nachher stets bedient habe und welche, obwohl dieselbe eine zufällige ist, wie ich fand, wenn auch nicht völlig, dann doch annähernd mit der Teilung des Thermometers übereinstimmt, welches im Pariser Observatorium hängt. Nachdem ich so die erste Grundlage zur Verbesserung der Thermometer bei Hrn. Roemer gelegt hatte, fing ich an einige Bücher über Barometer und Thermometer zu lesen, und da ich hörte dass in den Französischen Memoiren der Académie des Sciences hierüber viel mitgeteilt wurde, legt ich mich mittels einer guten Grammatik und eines Wörterbuchs auf das Studium der Französischen Sprache, welche ich auch wegen des Latein in kurzer Zeit so weit beherrschte, dass ich die Schriften des Societät zu lesen und übersetzen vermochte, wodurch mir dazu ein grosses Licht in meinen Augen aufging, unter welchen dann hauptsächlich die Abhandlungen von Maraldi, de la Hire, und Amontons viel beigetragen haben, speziell der letztgenannte, weil er sich sehr grosse Mühe gegeben hat den Thermometern eine feste Unterlage zu geben. Von den Engländern, welche über das Barometer geschrieben haben, habe ich nur Boyle's Schriften gelesen, so weit dieselben ins Lateinische übersetzt sind, diejenigen der Societät habe ich niemals zu lesen angefangen als zum ersten Male im Jahre 1724, als ich als Mitglied aufgenommen wurde. Seit jener Zeit habe ich es so weit gebracht, dass ich auch deren Schriften lesen und zum grössten Teil verstehen kann. Die sind somit Kurz gesagt die Mittel, durch welche ich auf den Weg der Verbesserung gelangt bin, womit ich hoffe dass Eurwohlgeboren zufrieden sein werden. . . ."

mately, though not exactly, with the division of the scale of the thermometer that hangs in the Paris Observatory. After I had in this way obtained from Herr Roemer the first basis for an improvement of thermometers, I set about reading some books on barometers and thermometers, and as I heard that much concerning them had been reported to the French Academy of Sciences, I undertook the study of French with the aid of a good grammar and a dictionary. On account of [my knowledge of] Latin, I had in a short time so far mastered it that I could read and translate the papers of the Academy.

There has been much dispute (*1*, *2*, *3*, *4*, *18*) regarding the definition of Roemer's thermometric scale and the origin of the strange number (7½) assigned to the ice-point. As has already been seen, it appears quite certain that the 7½ is an experimentally derived value, and that the lower fiducial point is intended to be, at least approximately, at the extreme low temperature of a water-ice-NH_4Cl mixture. The procedure here described by Fahrenheit throws additional light on the subject.

It will be noticed that the temperature of the warm bath is exactly 15 of Roemer's degrees above the ice-point, and that 15 is exactly one-fourth of the range of his 60° thermometer. And the zero is exactly half of this 15 below the ice-point, thus placing the ice-point above the zero by exactly one-eighth of the entire range from zero to the boiling-point.

These successive halvings remind one of Roemer's procedure in determining the approximate equivolume lengths of a conical tube, as given in *Adversaria*. In that, he halves the whole, then halves the halves, then halves the quarters. Possibly he was accustomed to using a 1-to-2 proportional divider. The amount of work he expended in deriving approximate formulas for an expeditious determination of the successive lengths indicates that he was impatient of exact computations that were long and laborious, and replaced them, if possible, with shorter, more expeditious, approximate ones. All of which suggests that the 7½ may have been arrived at in a similar way, and was adopted for a similar reason.

That reason is not far to seek. As remarked by Fahrenheit (*12*), the experimental realization of the lowest temperature attainable with a water-ice-NH_4Cl mixture is difficult; and is more difficult in warm weather than in cold. The faster the ice melts, other things being the same, the lower is the concentration of the salt in the water adjacent to the ice, and the higher the temperature of the mixture. The uncertainty so caused must have been very annoying and time-consuming in the adjusting of thermometers; and Roemer's apparent temperament would lead him to seek a more expeditious method for inferring approximately that temperature from another that could be determined more readily. Such a temperature is the ice-point, which he found to lie above his lower fiducial point by approximately one-eighth of the entire range of his 60° scale. Consequently, he placed his zero so that it was exactly one-seventh as far below the ice-point as the boiling-point was above the latter. That, in his opinion, placed it sufficiently near the temperature of the water-ice-NH_4Cl mixture for all practical purposes. Such an inferring of the position of his zero greatly expedited the work, and increased the concordance between the several thermometers so adjusted. And it was entirely satisfactory if the relation used was correct. But if the relation were in error, then his lower fiducial point would cease to be defined by a natural phenomenon (the lowest temperature of a water-ice-NH_4Cl mixture), and would become merely that temperature which lies below the ice-point by an amount that is exactly one-eighth of the difference between his two fiducial points. By reference to Table 2, it will be seen that his zero lies at 6.3°F., and so is a rather poor approximation to the low temperature of the ice-salt mixture.

Much discussion (e.g., *1*, *2*, *3*, *4*, *7*, *14*, *18*, *19*) has also arisen over Fahrenheit's statement that the 22½ bath was at blood-heat. It may easily be seen that 22½ on Roemer's 60° thermometer corresponds to 83.4°F., approximately, where, as elsewhere in this paper, °F. refers to the Fahrenheit scale of today. We now call 98.6°F. blood-heat, which is markedly

higher than the temperature corresponding to 22½ on Roemer's scale. But that does not tell the entire story. The question is this: What would be the reading on the scale of today of the temperature that Roemer regarded as blood-heat? To that question we have no answer, unless it be Fahrenheit's statement regarding the 22½ bath. A similar question arises regarding the temperature which Fahrenheit regarded as blood-heat. Such questions have been quite generally overlooked in discussions of the older scales.

One thing, however, is certain. There were only two ways in which Fahrenheit could have used Roemer's 22½ in graduating his own thermometers. Either he must have known of a natural phenomenon, realizable in Amsterdam, that yielded that temperature, or he must have had a thermometer, carried back with him to Amsterdam, with which he had determined the temperature of the 22½ bath. There is no indication in the letter, or elsewhere, so far as I know, that he had such a thermometer. And he states most explicitly that he understood that the bath was at blood-heat. There seems to be no doubt that he relied on that understanding to enable him in Amsterdam to reproduce the temperature of Roemer's 22½ bath.

Whether Roemer told him that the bath was at blood-heat, thus indicating that he thought that temperature to have the very low value of 83.4°F., or whether Fahrenheit either misunderstood Roemer or jumped to the conclusion that the warm bath was at blood-heat, it is impossible to determine with certainty. But in accordance with what has just been written in reference to the 7½, I am inclined to think that the 22½ point was determined solely by the condition that it should lie above the ice-point by exactly one-fourth of the total range of Roemer's 60° thermometer. If such were the case, then Fahrenheit was mistaken in thinking that the temperature of the 22½ bath was blood-heat.

Actually it makes very little difference whether or not Roemer did regard the bath as being at blood-heat. If he did, then Fahrenheit's scale would not agree with his unless each man accepted the same actual temperature as blood-heat; and it will presently be seen that they could not have done so. If Roemer did not regard the bath as being at blood-heat, then again Fahrenheit's scale could not have agreed with his except by accident, because of Fahrenheit's mistaken impression that the bath was at blood-heat. In spite of Fahrenheit's very laudable desire to make his scale accord with Roemer's, such an accord was necessarily absent unless each man accepted 83.4°F. as blood-heat; and Fahrenheit certainly did not accept that value.

In the letter to Boerhaave, Fahrenheit states that prior to 1717 he denoted the ice-point by 7½ and the temperature which he accepted as blood-heat by 22½, "which division I also used until the year 1717." "Since this division is inconvenient and inelegant on account of the fractional numbers, I decided to change the scale, and instead of 22½ or 90, to use 96, which I have done ever since."

Like his other writings about the graduation of his thermometers, this is decidedly vague—perhaps intentionally so, for commercial reasons. Just what does the last quoted sentence mean? A mere multiplication by 4 removes the fractions. What change, or changes, did he actually make? Did he merely designate by 24 (or 96) the mark that had previously been designated by 22½? Or was blood-heat thereafter supposed to be denoted, not by the 22½ mark, but by a higher one, to be designated by 24? Was the thermal size of a degree the same after the change as before? Relying solely on the information given in the letter, no one can be sure of what he actually did. The difficulty lies in the fact that two points are necessary for defining his scale, and he writes of only one.

But the problem is not entirely insolvable. One can make a very fair guess as to how he determined and numbered his initial scale. Furthermore he states in his letter (written in 1729) that he was still using the later (1717) scale at that time, and there seems to be no known record indicating that he ever changed that scale. Hence it seems fair to assume that the Fahrenheit scale of

today, except for a possible factor of 4, is the same as his 1717 scale; and so one can reason back to his earlier scale and conclude with fair certainty exactly what change he did make. That may be done as follows:

In accordance with his understanding of Roemer, he graduated his early thermometers in terms of the temperature of the ice-point and of that of blood-heat (as understood by him), choosing the size of the degree so that exactly 15 lay between those two points, and assigning to each division a number reckoned from a zero supposed to correspond to the lowest temperature of an ice-salt mixture and placed by inference at a point that was half as far below the ice-point as that was below the division corresponding to what he thought was blood-heat. And following Roemer's procedure, he determined the position of the blood-heat mark by immersing the new thermometer in a bath adjusted in terms of an auxiliary thermometer. By using always the same thermometer for adjusting the bath, he obtained a high concordance between his several thermometers. It is known that Fahrenheit devoted much study to thermometers. He considered the effect of changing the glass. He studied discrepancies between mercury and spirit thermometers. So it is not at all unreasonable to suppose that he studied the lowest temperature of the mixture of water-ice-NH_4Cl, and the temperature of blood-heat as observed in different warm blooded animals and under different conditions; and that, as a result of such studies, he found that blood-heat (defined as the temperature in the mouth or armpit of a healthy man) was higher than he had previously thought, seeming to be about 16 of the degree divisions of his thermometer above the ice-point, instead of 15, as he had previously supposed; and that the temperature of the ice-salt mixture lay a little more than the assumed $7\frac{1}{2}$ divisions below the ice-point. Hence, he accepted 16 for the first; which, with Roemer's one-half relation, led to 8 for the second. That is, he lowered his zero by one-half, thus raising by the same amount the numerical designation of each of his other degrees and eliminating the halves from the numbers that correspond to the ice-point, to blood-heat, and to the boiling-point; and the 16th degree above the ice-point (i.e., his 24th degree) he called blood-heat.

If this guess is correct, then reckoning back from the Fahrenheit scale of today, one finds that his new scale of 1717 was either that designated in Table 2 as °F. or F.″ (i.e., one-fourth of °F.), and that his earlier scale was $F.' = F.'' - 0.5$.

Whence it appears that the Fahrenheit scale of today resulted from blunders. Fahrenheit's letter seems to indicate quite clearly that he initially desired to perpetuate Roemer's scale, but he did not obtain from Roemer the proper definition of the temperature of Roemer's warm bath. His mistaken belief that it was at blood-heat led him to the use of a degree that was significantly larger thermally than was that of Roemer's, but not so large as it would have been had he used for blood-heat the higher temperature adopted in 1717. However, when he adopted that temperature in 1717, he retained the same size of degree as he had previously used, but took for the temperature of the ice-salt mixture defining his zero a value 2°F. lower than before, thus retaining Roemer's one-half relation. That gave the Fahrenheit scale of today; at least well within the precision with which he knew the temperature of blood-heat and that of the ice-salt mixture.

One may well ask, as many have done: How did it happen that the boiling-point on such an unplanned scale is an integral number (212) of such degrees? It probably didn't. However, it obviously departed from an integral number by not more than 0.5°F., and that departure could be removed by suitably changing the thermal size of the degree, the change not exceeding 0.5 in 180, and that would require a shift of the zero by not more than (16/180)°F., the designation of the ice-point being kept unchanged at 32°F. Such a shift of the zero would be entirely negligible as compared with the uncertainty with which the temperature of the ice-salt mixture was known; and the change in the size of the degree would change the numerical designation of the temperature of blood-heat by less than

0.2°F., which is also negligible. Such an adjustment was probably made by some one, possibly by Fahrenheit himself in 1717. True, he says nothing about any such adjustment, but that is in keeping with his secretiveness regarding other details of his work.

It would be interesting to know whether Fahrenheit ever learned that his scales differed from Roemer's (°Ro in Table 2). There seems to be nothing available that throws any light on the subject, nor is there anything to indicate whether he knew Roemer's numerical designation of the boiling-point.

Another possible assumption, in my opinion much less probable than the preceding, is that Fahrenheit did not make any such further study of the temperature either of blood-heat or of the ice-salt mixture, but retained the values accepted in his earlier work, and merely reduced the value of the degree interval, so that 16 new degrees covered the same interval as was covered by 15 of his old degrees, If that were the case, then any given temperature designated by F_1 on his early scale would be designated by $F''=16F_1/15$ on his later one (see Table 2).

TABLE 2.—CORRESPONDING TEMPERATURES AT FIXED POINTS ON EACH OF SEVERAL SCALES DERIVED FROM ROEMER'S SCALE.

°F	F'	F'	F_1	$4F_1$	°Ro
	°F/4	F'−0.5	15F''/16		
212	53	52.5	49.69	198.8	60
96	24	—	22.5	90	—
92	—	22.5	—	—	—
83.4	—	—	—	—	22.5
32	8	7.5	7.5	30	7.5
6.27	—	—	—	—	0
2.0	—	0	—	—	—
0	0	—	0	0	—

What then may one fairly infer about what Fahrenheit learned from Roemer? that is, what that might not as readily have been learned from others? Not more than two things: (1) He may have learned the desirability of using a bath adjusted to blood-heat by means of an auxiliary thermometer, rather than of using directly the body or interior of a warm-blooded animal, for determining the position of the top of the thermometer column when the temperature is that of blood-heat. But the advantage of using such a bath is so obvious that it may have been well known to him before he met Roemer. (2) By far the most important, and perhaps the only, thing he learned from Roemer was the idea of inferring the position of the top of the column when at the temperature of the ice-salt mixture from its position at each of two other temperatures—the ice-point and (in his case) blood-heat. The learning of that trick was of extreme importance.

Meyer makes much of the fact that the numbering of the divisions of Fahrenheit's scale suggests Roemer's scale, and of his statement (in the letter) that he initially divided his scale in the same way as did Roemer. But that indicates no more than his recognition of the advantage of avoiding a multiplicity of scales. Roemer seemed to have a satisfactory and reproducible scale; so Fahrenheit decided to make his accord therewith, not because Roemer's was an ideal scale, but simply for uniformity. Unfortunately, apparently on account of a misunderstanding, each of Fahrenheit's scales departed markedly from Roemer's. Consequently, one is scarcely justified in saying, as Meyer does, that Fahrenheit obtained his scale from Roemer.

From all this it seems obvious that although Roemer had clear and correct ideas as to how thermometers should be constructed, (*a*) his work on thermometers was of little importance, because he never published his ideas and never made his thermometers available to others. (*b*) How many thermometers he made is not known, but a note by Horrebow, in *Adversaria*, states that Roemer's widow had given him 5. (*c*) From Roemer's outstanding reputation, one might infer that thermometers made by him were very superior instruments, but the very meager available records are not sufficient to substantiate that inference. (*d*) The principle of defining a thermometer scale by means of two fiducial temperatures was well known long before Roemer's day, having been proposed and used by several throughout the century preceding his work. (*e*) The fiducial points

that Roemer seems to have aimed to use were the lowest temperature of a mixture of water-ice-NH_4Cl, and the temperature of boiling water; but nowhere does he mention any use of the temperature of that mixture. In his later thermometers, that temperature was inferred from the ice-point by means of a none too accurate approximation. (*f*) Fahrenheit did not state in his letter to Boerhaave (April 17, 1729) that he had learned from Roemer the idea of defining the scale by means of two fiducial points. (*g*) Fahrenheit stated that he saw Roemer determining the positions, on certain thermometers under construction, of two fixed points—the ice-point and a point marked 22½, which he (incorrectly) assumed to indicate blood-heat, but he said nothing about either the size of the thermometers or the use to which they were to be put. (*h*, *i*) Fahrenheit stated that he at first divided his scale in the same manner as he had seen Roemer divide his, but he divided each division into quarters. However, as has already been seen, the temperature to which he assigned 22½ was not that to which Roemer assigned the same number. (*j*) Fahrenheit stated that he retained that type of division until 1717, but he did not state that his thermometers were limited in length to 22½ (or 90) divisions. (*k*) He did not state clearly what changes were made in 1717, but as has been shown it is fairly certain that they consisted solely in placing his zero lower by a half of one of his original degrees, and in designating the resulting 24th (or 96th) degree as blood-heat. (*l*) He did not directly state that he retained Roemer's ratio of the thermal intervals between zero, ice-point, and blood-heat, but he did retain it, and he might have expected one so to infer from his statement that he at first divided the scale in the same manner as he had seen Roemer do it. However, the temperatures corresponding to his zero and blood-heat were quite different from those corresponding to Roemer's zero and 22½. (*m*) Roemer did not invent the modern thermometer, the Fahrenheit thermometer has never accorded with Roemer's, and all credit for it belongs to Fahrenheit alone.

With these conclusions compare the following statements composing a section of I. B. Cohen's recent booklet (*5*), mentioned at the beginning of this article. He gives as his authorities Kirstine Meyer (*20*) and the Fahrenheit letter (*7*) and relies somewhat on N. H. deV. Heathcote's summary (*21*) of the latter. They represent Meyer's conclusions, but some are a little more emphatic. For convenience in comparison the several sentences have here been lettered so as to indicate the corresponding statements in the preceding paragraph.

"32. (*a*) Of great importance is Roemer's work on the thermometer. (*b*) Roemer constructed many thermometers and used them in his astronomical work as well as to record the daily temperature. (*c*) These thermometers were designed by him and were superior to any that had been used previously. (*d*) He it was who first realized that the scales of thermometers giving concordant readings must be based on *two* fixed points, not just one. (*e*) The two points he used were the boiling point of water (which he marked 60°) and the melting point of snow or crushed ice (which he marked 7½°), so that a mixture of crushed ice or snow and sal ammoniac would give a zero reading). (*f*) In a letter to Boerhaave in 1729, Fahrenheit (1686–1736) states that he met Roemer in Copenhagen in 1708 and from him learned the fundamental principle of the two fixed points. (*g*) Also, that he saw Roemer in the process of testing small thermometers for meteorological use; these were divided into 22½ parts and had as fixed points 7½° (ice water) and 22½° (blood heat). (*h*) Fahrenheit adds that he himself adopted the same temperature scale, but with two minor changes. (*i*) These were the use of Roemer's zero (snow and sal ammoniac) as the lower fixed point rather than 7½, a convenience pure and simple, and the use of a scale division arrived at by dividing each of Roemer's scale divisions into four such, for ease of reading. (*j*) Fahrenheit kept the scale in this form, with 90 divisions, until 1717. (*k*) At that time, in order to avoid the clumsiness of fractions, he replaced the 90 divisions by 96. (*l*) He 'retained Roemer's general arrangement whereby one-third of the whole range lay between the zero and the melting point, and two-thirds between the melting point and blood temperature; the melting-point thus became 32° and blood temperature 96°' (see Heathcote's article [*21*]). (*m*) Thus it is quite clear that it was Roemer who in-

vented the modern thermometer and that the Fahrenheit thermometer should, in all fairness, be called the Roemer thermometer!"

It will be noticed that nearly every statement in the quoted section is at least misleading, and some are actually false.

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ETHNOLOGY.—*Bird lore of the Eastern Cherokee.*[1] JOHN WITTHOFT, University of Michigan. (Communicated by W. N. FENTON.)

The Eastern Cherokee of Qualla Reservation, North Carolina, are the only large group of the aboriginal peoples of the southeastern United States who still occupy a portion of their native habitat. They represent the only intact ethnic group that is still in daily contact with the country of its ancestors, and with the living creatures that shared that territory. Thus any study of the ethnobiology of the Southeast must emphasize the Cherokee data as of primary importance. This study is intended as one contribution to the understanding of the relationship between man and nature in the southeastern mountains: a relationship that recognized and utilized the members of man's natural environment according to certain patterns and concepts that were basic to the cultures of the area. That relationship has nearly ceased to exist, and we should like to know what were the processes that led to its loss. In an acculturation process, the people's contact with nature and traditional knowledge of the various aspects of natural history may be one of the first constellations destroyed. This may precede the loss of use of the native language and is even a part of it, for the specialized vocabularies concerned with birds, plants, insects, and animals are very readily abbreviated and simplified. It is possible that this instability of nature lore explains the small amount of such information in print for the smaller Indian remnant groups still living in the eastern United States.

The North Carolina Cherokee live on the upper reaches of the Oconalufty River at an altitude of about 2,100 feet, with nearby mountains rising as high as 3,000 feet. This is above the range of chuck-will's-widow,

[1] This study was made possible by a grant-in-aid, for field work among the Eastern Cherokee, from the Department of Anthropology Research Funds of 1944, 1945, and 1946 of the University of Pennsylvania. Received August 30, 1946.

the red-bellied woodpecker, and the shrike. The adjacent mountains are high enough to support pure stands of balsam fir, *Abies balsamea* (L.) Miller. Both the flora and fauna include northern and southern elements of several zones.

Notes on Cherokee bird lore were gathered during three visits to Qualla Reservation in 1945–1946. Data was obtained from about 15 informants, mainly from the towns of Big Cove, Birdtown, and Painttown, but the bulk of the material is from six persons, generally referred to hereafter by their initials. Will West Long (W.W.), of Big Cove, age 75, recognized over 100 Cherokee bird names, all of which he believed to be traditional. He had a good knowledge of the birds about him and was generally able to identify nests and eggs. Mollie Sequoyah (M.S.), of Big Cove, a few years younger than Will, probably knew nearly as many birds, but I did not concentrate on birds when working with her. Her names and traditions agreed very closely with Will's. Cain Screamer (C.S.), of Painttown, age about 55, recognized about 50 bird names, and his knowledge of birds and plants was much less thorough than that of the older informants. Other informants of about his age and conservatism showed a similarly imperfect knowledge of Cherokee natural history. Moses Owl (M.O.), of Birdtown, age about 60, speaks English slightly better than he does Cherokee and knew Cherokee names for about 50 birds, some of which he could recall with difficulty. His knowledge of local White bird names was exceptionally good, and he is a much better naturalist than his Cherokee bird vocabulary would indicate. Jimsie Wallace and Takwat Wallace (J.T.W.), of Adams Creek, Birdtown, father and son, age about 75 and 50, speak little English and are very much men of the woods. They recognized about 60 bird names but probably could give more. Some differences in classification and terminology are noted between the data from Birdtown and that from the Big Cove-Painttown-Wolftown portion of the reservation. Some linguistic differences are also noted between these sections, and it seems probable that an old areal differentiation exists here. Will West Long was in some cases able to recall forms which he had heard in the Oklahoma Cherokee dialect, and I have included them, marked Oklahoma. (This is the western dialect; all the other names are in the middle dialect, the eastern being extinct.)

Most of the work was done over sets of bird plates, the most usable of which was a set of pictures of birds of the Cherokee area selected from the National Geographic Magazine series. Forbush and May's *Birds of the Eastern United States* was found to have better drawings, but the book was too bulky and the pictures of unfamiliar birds tended to confuse informants, so less use was made of this work. Chester Reed's bird guides are the most convenient, but the illustrations are so ill-suited to this purpose that I prefer not to use them—too much confusion results.[1] Dead specimens of birds I happened to find were used whenever possible, and names and data were obtained on the live birds I saw when with informants. I utilized the local English names as much as possible. The authority for most of the Cherokee bird names and for most of the folk material is indicated in this study by the initials of the informant (in parentheses); where no authority is given there was general agreement. The small amounts of data derived from other informants than the ones listed were included in their information, and so have not been indicated. The more pronounced phonetic variants are also included to indicate variability and in the hope that they may some day be of use to the linguists studying Cherokee.

Birdlife was of considerable significance to the Cherokee. Birds had their place in Cherokee religion, folk practice, and medicine, and the content of the folk traditions would indicate that the Cherokee found considerable esthetic interest in them. But the use of birds and their eggs as food overshadowed all other considerations. In the lean winter months birds of all types were caught on the snow with a baited cage-fall or board-fall trap set with a figure-four

[1] My own identifications and the terminology used in this paper are based upon Roger Tory Peterson's *A field guide to the birds*. Boston, 1939.

trigger or a pull-stick trigger. In summer, birds were shot out of trees with a blowgun, caught in traps, and driven out of brush heaps at night with torches and beaten down with sticks. These birds were roasted over the fire and eaten out of their skins. Children and other persons in the woods and fields gathered edible plants, mushrooms, frogs, edible insects, and bird eggs and nestling birds. These were either eaten on the spot or carried home for a meal. The Catawba of South Carolina cooked small birds into meat pies, such game being frequently their only food, but the Cherokee always roasted their birds. According to Will West Long, hawks, owls, eagles, buzzards, crows, wrens, whippoorwills, and kingfishers were not eaten, but all other birds were. The head of the crossbill was not eaten because it tasted strongly of balsam, but the body of the bird was eaten. Needless to say, birds and eggs are now rarely hunted for food, but the older informants gathered much of their bird lore by killing and eating most of the kinds about them. This may partially explain the exceptionally large number of birds recognized and the bulk of folklore pertaining to them, and may indicate one reason why this knowledge is not being perpetuated.

Besides the fall-traps, special traps for turkeys and eagles were known. Will West Long's older sister made noose traps for small birds from strands of her hair, but Will does not remember how they worked. The blowgun (tu'gwes'di') was a major hunting implement. It was made of an 8- to 14-foot piece of cane, bored and smoothed inside, and was hung by one end when not in use. The darts (dzid'zi—the name of the thistles with which they were tufted—*Cirsium* spp.) were about 9 inches long, made of hickory or of stems of the bush clover (*Lespedeza capitata* L.) and wrapped with thistledown and bound with thread at one end, the other end being pointed. With this weapon birds were shot as they were feeding or resting and were not disturbed by the sound of the darts. According to Moses Owl, the shaft of a dart was held across the lips as an aid in imitating bird calls. Even rabbits (struck in the neck), squirrels (struck in the eye), and frogs and toads were taken with the blowgun. A Cherokee could kill a robin at 40 feet with a blowgun.

Earlier Cherokee studies by James Mooney and Franz Olbrechts included random notes on Cherokee bird lore, some of which are referred to later in this paper.[3] A. L. Pickens published two lists of Cherokee bird names, drawn largely from the published sources and from Will West Long.[4] The manuscript of his second paper, preserved in the archives of the Bureau of American Ethnology, is of considerable interest because it includes notes by Will West Long on the names he recognizes and the names are written in the Cherokee syllabary.[5] Pickens's studies include a number of names that I have not collected, but I have not checked these with informants and do not know their source. His names are not phonetically recorded, and many of his interpretations are highly improbable.

Djiskwa'' is the general word for bird in Cherokee, but it is almost never found as a part of a compound bird name. Will thinks he has heard a parrot called gawɔ'ni·sgi' dji·skwa', "talking bird," but no other bird names are constructed after this fashion. One of the seven Cherokee clans is called anidji·skwa', "bird people." (The name for bird is both singular and plural, but the clan name forms a plural.) One special group of birds, the sparrows, receives a signal honor, for its members are called dji·skwayę́, "really a bird, genuine bird."

The "crane," as the herons and egrets are known locally, is called kąskowę́, this being the generic name (W.W.). The "white crane" is probably the American egret, *Casmerodius albus egretta*. The great blue heron, *Ardea herodias*, called skot'ski, per-

[3] MOONEY, JAMES, *Myths of the Cherokee*. 19th Ann. Rep. Bur. Amer. Ethnol.: 1. 1900; *Sacred formulas of the Cherokees*. 7th Ann. Rep. Bur. Amer. Ethnol.: 301–397. 1891. MOONEY, JAMES, and OLBRECHTS, FRANZ, *The Swimmer Manuscript*. Bull. Bur. Amer. Ethnol. 99. 1932.

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haps referring to "feathers on head" (W.W.), is generally referred to merely as kąskowǫ́ (kąnskowǫ́, C.S.; kąskawǫ́ kalaskowǫ́, J.T.W.). The little blue heron, *Florida caerulea*, and other wading birds were not recognized by my informants. The great blue heron, at least, was shot and eaten by the Cherokee when it wandered into their territory (M.O.).

The Cherokee seem to have very little knowledge of waterfowl, probably because of the upland, well-drained country in which these people lived. All geese, both wild and domesticated, are called s'as'a or sas'a. In Birdtown ducks are called a'dɔ·ni', but the people of the Big Cove and the adjacent settlements use a different name, kawɔ·na. In Birdtown one variety of a'dɔ·ni', the teal, known locally as "dart apple," has received a distinguishing name, ekskwayę'. One variety of domesticated duck, the Muscovie duck, locally called skogi' duck (i.e., Muskogie duck), is named djokskwani' in Birdtown.[6] All other ducks are known by the generic name, and the different varieties do not seem to be distinguished by any qualifying adjectives.

The general name for hawk is tawɔ·di', a term generally used instead of the specific name of each hawk. Diga·k? dǫ'nahigǫ', "long tail," is the sharp-shinned hawk, *Accipiter velox*, and probably also Cooper's hawk, *Accipiter cooperi;* both are called locally "marsh hawk" and "chicken hawk." The red-tailed hawk, *Buteo borealis borealis*, is called uwes'la'oski, "love sick," because his note is such a lonely whistle. (He says ju'ju! jijijijiji skwe!, according to Will.) He is locally called "mountain hawk" and "chicken hawk" and is known also as tawɔdehu', "hawk big" (W.W.), utąⁿta'wɔ·di', "big hawk" (J.T.W.), and tawɔ·dɛgwǫ', "hawk big" (C.S.). Big Cove is named tawɔdihi", "hawk place" (W.W.).

The red-shouldered hawk, *Buteo lineatus lineatus*, is known locally as the "brown rabbit hawk" and is called gido·diski', "live thing on ground, he snatches up" (W.W., J.T.W.). Will believes that this name may have originally referred to the golden eagle and that it does not properly apply to this hawk. The red-shouldered hawk is invoked in one of the conjurors' formulae to carry away disease.[7] The marsh hawk, *Circus hudsonius*, has simply a name, ga'lonudzi'.

The broad-winged hawk, *Buteo platypterus platypterus*, called "pigeon hawk," is considered a fast and most graceful bird and is called s'anɛ·wá (Oklahoma form—tlanɛ·wa') or s'aniwǫ'nǫ'; the name is said to mimic the sound of his flight.[8] A giant variety of this bird, called by the same name (specifically referred to as s'anɛ·wa'.u·tana', "pigeon hawk big"), is one of the most important birds in the Cherokee mythology. Like the giant snakes, these birds were well remembered by all Cherokee and are frequently referred to as having been recently exterminated.[9] One rock cliff on the Tennessee River was known as sanɛ·wɔhi' ("pigeon hawk place"). A pair of these giant birds once had a nest there. One of them carried off a live man to their nest, and he ate and slept with the young birds. When the old birds were home he was under constant and hostile surveillance and got no food, but when they were away the young birds fed him and played with him. They taught him a dance, in which he impersonated the hawk pursuing and catching pigeons. When the young birds were large enough to fly he attempted to escape on the back of one of them. When it had flown a distance from the nest, he struck it on the head with a club, stunning it. The bird glided to earth, and he escaped. The dance he learned is still known to the Cherokee and is called the pigeon dance (W.W.). James Adair, a

[6] The Creek Indians, southern neighbors of the Cherokee, also distinguished this variety of duck by a separate name, fu'tc'o.su'li, "duck-buzzard" (Loughridge, R. M., and Hodge, D. M., *Muskogee Dictionary:* 139. 1890). This bird may have been an early introduction among the southeastern Indians.

[7] MOONEY, *Sacred formulas:* 356.

[8] All sorts of difficulties are involved in identifying the bird that an Indian informant recognizes. Will identified pictures of the pigeon hawk, *Falco columbarius columbarius*, as this bird, probably because he was misled by a local name, and the plates were, unfortunately, labeled. The tail of this hawk which he and Mollie brought me later, however, belonged to a broad-winged hawk. Many of the identifications in a study of this sort remain somewhat uncertain.

[9] MOONEY, *Myths:* 315.

trader among the southeastern Indians in the mid-eighteenth century, has recorded what apparently is a reference to this tale. He says that the Cherokee disliked miserliness and lack of hospitality and had a proverb or jibe that they said of inhospitable people, "Sinnawah na' wora', the great hawk is at home." (This phrase is in the extinct Eastern Cherokee dialect.)[10]

The eagles are known as awɔhuli", which Will interprets as meaning "across the highest mountain." Will says that this name is used only for the bald eagle, *Haliaeetus leucocephalus leucocephalus* (awɔ·hɔli" C.S.; awɔ·hɑli', J.T.W.).

The eagle was a most important bird to the Cherokee and was a symbol of peace. The Eagle Dance, equivalent of the widespread Calumet Dance, was a men's performance in which several dancers carrying gourd rattles and dance wands decorated with eagle feathers pantomimed eagles with conventionalized steps, this dance being emblematic of peace. Several good early descriptions of such a dance with eagle tails exist.[11] This dance was performed to welcome visitors and to greet the dead eagle when it was carried into the town. Eagle tails were highly valued, and the killing of an eagle was a considerable undertaking.[12] Formerly special officers were entrusted with this job. They called the eagle to them with spoken charms and memorized formulae and then shot the bird. This could only be done in fall, else the rattlesnakes, not yet in their dens, would be angered by the Eagle Dance songs and attack people, and an early winter might also appear. The body of the slain eagle might bring disease to those who handled it, and so it had to be left untouched for four days (W.W.). The body had to be beaten all over with a stripped sourwood (*Oxydendrum arboreum* (L.) DC.) switch to drive off the diseases before it was touched (M.O.). As far as I know, the last eagle to be shot on the reservation was killed about 1937.

Jimsie and Takwat Wallace described an eagle trap unknown to my other informants. A number of long poles were driven into the ground to form an open tipi-like structure, with an opening at one side covered by a sliding door of sticks. This door was propped up by a stick, and a string ran from this stick to a hiding place nearby, where the trapper lay in wait. A small animal, such as a groundhog, was tethered by a string to a stake inside of the trap. An eagle, attempting to catch the animal, would pursue him into the trap and would be caught when the hunter pulled the string. I am not at all sure that such a device would work, but it may possibly have been used in some Cherokee communities.

The last eagles in the Big Cove were killed by a white man in the 1890's. A colony of bald eagles had lived there, unmolested except for an occasional individual killed ritualistically, up to that time. Will had taken an eagle according to the prescribed manner in his youth. Abel Blankenship, a white man who claimed Indian descent and was thus permitted to hold one of the better farms in the Big Cove, contracted with a live-animal dealer to sell him a live eagle. He set a trap, presumably a steel trap with the jaws wrapped in cloth fastened to a baited pole-perch, and caught an eagle. Figuring that two eagles were better than one, he trapped the entire colony of 12 and put them in a chicken-wire pen. The live-animal dealer was never seen again, and the eagles died in their cage.

John Taylor ("Old Man Ducksoup," deceased), of Birdtown, described to Moses Owl a peculiar Eagle Dance performance he had seen in his youth. A group of men painted as one kind of eagle and wearing eagle tails, masks, and claws was approached in a dance by a man and woman similarly disguised as a different kind of eagle. In this dance the woman was surrounded and carried off by the other men, but her partner finally was able to maneuver her away again. We have no other data on such a dance or on similar costumes,

[10] ADAIR, JAMES, *History of the American Indians:* 16. London, 1775. Another variant of the Roc myth occurs among the Seneca Iroquois of New York as the origin legend for the Eagle Dance (W. N. Fenton).

[11] TIMBERLAKE, HENRY, *Memoirs*: 107. London, 1765. MOONEY, *Myths*: 281, 492–493. WILLIAMS, S. C., *Early travels in the Tennessee country:* 126. Johnson City, Tenn., 1928.

[12] MOONEY, *Myths:* 281, 283–284, 453.

but the whole performance is suggestive of certain copper and shell art objects from the mounds of the Creek area, in which men painted and garbed like several different species of conventionalized raptorial birds are portrayed in various sequences of a dramatic performance.

The osprey, *Pandion haliaetus carolinensis*, called "fish hawk," is known as kanu'dju^{hu}wa", "lucky at fishing" (W.W.) (kanᵋ'djuwᵠ́, J.T.W.; konᵃg'iwᵠ', C.S.; kanᵠtsu'wa", M.S.). According to Will, the fat is tried out from the fish hawk's throat, mixed with *old* bear oil, and drunk as a cure for tuberculosis. The outermost feather (primary) from the right wing of the fish hawk is burned, powdered, and steeped in water; this is drunk for the same purpose.[13]

The sparrow hawk, *Falco sparverius sparverius*, is called g'i·g'i, because he says, according to the Cherokee, g'ig'ig'ig'ig'i. He is considered one of the prettiest of the hawks. Another hawk, called giya'giya', is mentioned in some of the conjurors' formulae, but the Cherokee now apparently know nothing of i s identity.[14]

The turkey vulture, *Cathartes aura septentrionalis*, is called su·'li'. This is also the Creek (Muskogean) name for this bird.[15] The Cherokee are impressed with the "buzzard's" immunity against disease, offensive odors (which are considered possible causes of disease), and corruption. Drinking the blood of the buzzard is said to give temporary immunity from all epidemic diseases (W.W.). A dead buzzard hung somewhere near the house is thought to have a similar effect. In one of the conjurors' formulae, buzzard's down is prescribed as a dressing for shot and arrow wounds.[16] The buzzard was once a handsome and proud bird, and one Cherokee story tells how he fell to his present low station in life.[17] It is also claimed that when a feeding buzzard sees you staring at him he vomits up everything in his stomach in your direction.

The ruffed grouse, *Bonasa umbellus monticola*, is known locally as "pheasant" and is called tᵠ'di·sti', "hear" (gatadiyᵃ', "I am hearing (now)"; datadisti', "I hear (habitually)"). If a pregnant cat eats any of the meat or entrails of a partridge, it is believed that the kittens will die within her. To prevent this the cat is made to drink a decoction of the leaves of the patridge berry, *Mitchella repens* L. (W.W.). Mooney records a similar Cherokee taboo against eating grouse, applied to pregnant women.[18]

The bobwhite, *Colinus virginianus virginianus*, is called locally "partridge" and "quail" and is called ^{ko}kwe (W.W.) or g'ugwe' (M.S.), perhaps in imitation of its call. The bobwhite once had no call, but got his whistle from the tortoise by trickery.[19] The guineafowl is called ^{ko}kwe dᵃgᵃ'nasᵃ·i", "quail domestic" (W.W.), or kokwehi' (J.T.W.), or merely ^{ko}kwe (C.S.). This bird is considered as a sort of watch dog to scare off intruders, and Will tells me that the guineafowl is most valuable because it warns of the approach of witches, especially of invisible ones.

The wild turkey, *Meleagris gallopavo silvestris*, is almost exterminated in the Cherokee area but was formerly an abundant and important bird. Both the wild and domesticated turkeys are called kanᵃ'. (According to Jimsie Wallace, the domestic turkey is kanᵃ'ᵈnaᵃ'ge·nehi', "turkey domesticated.") Will thinks that the wild turkey was also kept as a domestic bird in aboriginal times and says that his mother gathered wild-turkey eggs and hatched them under a chicken, handling them in leaves and being careful not to touch them herself.

There is more hunting lore concerned with the turkey than with any other bird. The turkey hunter knew certain memorized formulae with which to charm his prey; and

[13] This bird is also invoked by the conjuror as a piercing agent to carry off disease (Mooney and Olbrechts, *Swimmer Manuscript:* 190–191, 266).

[14] Mooney, *Formulas:* 382.

[15] Loughridge and Hodge, *Muskogee Dictionary:* 12.

[16] Mooney, *Myths*: 266. Mooney and Olbrechts, *Swimmer Manuscript:* 72, 272.

[17] Mooney, *Myths:* 293. Witthoft, John, *Some Eastern Cherokee bird stories.* Journ. Washington Acad. Sci. 35: 179. 1946.

[18] Mooney, *Myths:* 295.

[19] Mooney, *Myths:* 289. Witthoft, *Bird stories:* 178.

often wore a mask of bobcat fur made to look like the face of a bobcat. According to Will, who has killed turkeys this way, the turkey was not frightened by what appeared to be a bobcat looking over a stump or around a tree trunk. These masks were also used to hunt bobcats and were worn in certain dances. A small tube of bird bone, one end held in the mouth and the other between the cupped hands, could be sucked to make a good imitation of a turkey's gobble (W.W.).[20] But the best and most curious turkey call was used in Birdtown. A slip of cane or bone, sharpened to a chisellike edge, was set in a corncob. A flat sheet of shale was held over the cupped left hand, and the scraper, held perpendicular to the shale, was scratched across it. By varying the shape of the left hand and the stroke of the scraper, a very close imitation of the turkey's call could be produced. This instrument was called kuna'yeli'st'di^, "turkey scratch like" (M.O.).

Several types of traps were used for turkeys. In the Big Cove, a trench about 10 feet long was dug, slanting down from ground level at one end to about 3 feet deep at the other, and about 3 feet wide. Corn was scattered over the floor of this trench for several days, so that the turkeys would overcome their suspicion of this new feature in the landscape. Then a 3-foot-square pen of poles was built up like a log cabin, over the deep end of the trench, and covered with poles, there being large spaces between all the poles. The trench was again baited, and a turkey following the trail of corn with his head down came to the end of the trench, put his head up, and was caught. It is said that he would just stand there and poke his head out through the spaces in the pen, never thinking to bend over and go out the way he came in. All my Big Cove informants vouch for this trap, but the Birdtown people are vastly amused at such an impossible scheme.[21]

According to Moses's father, Adam Owl, turkeys were taken in Birdtown by means of a baited wooden hook on a string. The details are forgotten, except that the points of the hook expanded when the string was under tension.

The Cherokee once no doubt wove feather mantles in which turkey feathers were used, but no memory remains of such a usage. The "beard" (vaneless neck feathers) of the turkey was used as a fringe around the top of some of the single eagle feathered Cherokee headdresses. This "beard" was once the property of the Tortoise's wife, but the Turkey traded the Tortoise some worthless beads for the neckpiece.[22] A bone tube made of the thigh bone of the turkey was used by Cherokee doctors to blow certain medicines on the body and into the throat of a patient. There is no evidence that the Cherokee ever used the turkey spur as an arrowpoint.

According to Will West Long, sandpipers are called kanastu·'wa', "they put their legs in water," but Jimsie and Takwat Wallace insist that this name refers to the killdeer, *Oxyechus vociferus vociferus*. The name is preserved in several of the memorized formulae used for curative purposes. Will calls the killdeer, dj'osto·wa', and tells of a medicinal formula in which red, white, brown, and blue birds of this name are invoked to cure a patient suffering from stomach trouble. Gulls are known at u'ti, which also means "turnip"; this name is also preserved in some of the formulae. The "snipe" (Wilson's plover, *Pagolla wilsonia wilsonia*, and the woodcock, *Philohela minor*) is known as gala'sǫyaha', "bill dragging on ground," but Will thinks this name is properly applied only to the woodcock.

The mourning dove, *Zenaidura macroura carolinensis*, called "turtledove," is known as gule'dᵻskon'jhį', "acorn he cries for," because the bird is thought to call gule', gule', "acorn, acorn." This name is also thought to

[20] SPECK, FRANK G., *Remarks on Izikowitz's "Musical Instruments of the South American Indians,"* Ethnos 2: 94. 1937.

[21] Similar traps have been described for Delaware and Rappahannock groups. See: DODGE, ERNEST S., *Notes from Six Nations on the hunting and trapping of wild turkeys and passenger pigeons.* Journ. Washington Acad. Sci. 35: 342. 1945.

[22] MOONEY, *Myths:* 287. WITTHOFT, *Bird Stories:* 179.

refer to the passenger pigeon, *Ectopistes migratorius*, but an older name for this bird, wɔ·yi′, is preserved in several of the memorized formulae, and Henry Timberlake, in 1765, gives "woey" as the name for the pigeon.[23]

The yellow-billed cuckoo, *Coccyzus americanus americanus*, is known as da'ɬᵉga′, that being the Cherokee imitation of his call (W.W., M.S.). Jimsie and Takwat Wallace call this bird djustig'iski′.

The owls are of some importance in Cherokee folklore and are generally considered birds of ill omen. Jimsie Wallace gives me the name uguku'tawɔ·di′, "barred owl, hawk," for the barn owl, *Tyto alba pratincola*, but my other informants recognize neither the bird nor this name. The screech owl, *Otus asio naevius*, is called wahahu′, in imitation of its call, and is considered rather an inoffensive bird. One Cherokee family takes its name from this bird. (Sally Owl, of Birdtown, for example, was really named sa·li" wahahu′.)

The barred owl, *Strix varia*, is called uguku, in imitation of its call. According to a popular Cherokee story, this bird was once a human being. He courted and married a Cherokee girl, but only came to the house at night and sat in the corner with his head turned, so that his wife and mother-in-law never saw his face. One night the old woman decided to play a trick on him, so she threw an armload of sumac sticks on the fire. When they began to flare up and explode, the husband was startled and turned to look. The girl and her mother saw his face, and began to laugh at him, saying, "Oh, what a funny looking thing you are!" The husband was so offended and ashamed that he ran off into the woods and has remained there ever since as an owl.

Moses Owl, whose name is actually mos'i' uguku', tells a somewhat different version of this story. Once a strange and beautiful bird appeared in the woods, and all the other birds gathered around and began to perform tricks and show off to attract her attention. She paid no attention to any of them, but she noticed one bird, an owl, just sitting there and looking off shyly in another direction. She went over to take a look at him and decided that she would marry the owl. "That," concludes Moses, "is how I got my wife," stealing a glance at his magnificent wife who came from Laguna Pueblo.

The long-eared owl, *Asio wilsonianus*, is the most dreaded of birds.[24] Variously considered as ill omen, witch, or avenger of breach of taboo, this owl is called s'ə'ki·li′, in imitation of its voice, a word which is also considered to mean "witch, wizard, something repulsive, simulator" (W.W.). The scream of the long-eared owl brings dread and terror to the heart of the conservative Cherokee, but the bird must not be killed.

The whippoorwill, *Antrostromus vociferus vociferus*, is almost as hated as the long-eared owl, and its cry is an ill omen. Witches are believed often to appear as whippoorwills. This bird is named waguli", because the Cherokee hear its call as wa'guli", wa'guli", wa'guli". When I showed Will a picture of this bird, he said, with obvious disgust, "Isn't that an awful ugly-looking bird; did you ever see anything uglier?" The whippoorwill is neither killed nor eaten. The nighthɔwk, *Chordeiles minor*, is locally called "bullbat" and is named ka'lsto·gᴀ′. No special folklore is associated with the nighthawk.

The chimney swift, *Chaetura pelagica*, locally called "chimney sweeper," is known as ᵊni'gostayi′, "they are sharp" (W.W.) (nigɔ·stᴀyę′, C.S.; negosta'i′, J.T.W., M.O.) This bird is noted for its speed and agility and is invoked by the ball player and a certain feather from its left wing worn in the hair to give swiftness in the ball game or in war (W.W.). According to Moses Owl, if this feather pointed upward the wearer was peaceably inclined, but if concealed in the hair and pointed downward the wearer was looking for blood. Moses also tells me that birds were invoked in some of the memorized love formulae, considered certain methods for catching the fancy of a girl. Some of these formulae consisted of songs to the chimney swift, cardinal, and blue jay. The aspiring young man sang one

[23] TIMBERLAKE, *Memoirs:* 71.

[24] WITTHOFT, *Bird Stories:* 180.

of these songs in the hearing of the girl; if she looked at him, she was caught; if not, he had to try something else. Certainly a rather neat formality, if not effective magic!

The hummingbird, *Archilochus colubris*, is called wa·lɛ·lu′, which has some reference to rolling. (Wheel is dagweˋlɛ·luˊ; W.W.) The kingfisher, *Megaceryle alcyon alcyon*, known as "kingfisher" or "woodhawk," is named tsatɔ′ (W.W.) (tsˊatɔwi′, J.T.W.; ᵈzatła·wa′, C.S.) because his call is interpreted as tsatlalala. A magical (spirit) kingfisher of the same name is invoked in certain formulae used by fishermen. The kingfisher is considered a symbol of piercing power and is therefore invoked in several medicinal formulae (W.W.). The beak of the kingfisher was given him by the Dwarfs or Little People as a reward for assistance he once gave them.[25]

The yellow-shafted flicker, *Colaptes auratus*, is called "yellowhammer" and named unɛˋgada′, "white dirt." Will says this is because the bird is frequently seen on the ground eating insects, when his rump shows up as a white blotch against the soil. The pileated woodpecker, *Ceophloeus pileatus*, is called the "wood hen" and is considered a lazy and stupid bird. Its Cherokee name is derived from its call, ᵏᵒkwoki′ (W.W.) (u?wɔ·ki′, J.T.W.; ?ko?kwokwa′, C.S.; kwaga′, Carl Standingdeer). The red-headed woodpecker, *Melanerpes erythrocephalus*, is considered a swift and cunning bird and is the great war symbol of the Cherokee; similar woodpeckers were very important in the war-symbolism of many other peoples in North America, the symbolic ornamentation with woodpecker scalps by the Plains tribes being one of the more conspicuous usages. The red-headed woodpecker was always invoked for aid by the ball player and is named in imitation of its call, dala′la′ (W.W.) (dalala′, J.T.W.; dalala′, M.O.; tlala′la′, C.S.).

The yellow-bellied sapsucker, *Sphyrapicus varius varius*, is named dzuli.ena′, "deaf," and is generally referred to as "red-headed woodpecker," this local name also including several other birds. According to one story, this bird was once an old woman, who was deaf.[26] The downy and hairy woodpeckers are called djiskwɛˋnuᵈza′ (W.W.) (tˊiskweˋnudja′, J.T.W.; gˊiskwɛnuᵈza′, C.S.), a name that may include the generic term for bird (djiskwa′).

The kingbird, *Tyrannus tyrannus*, is noted as a fierce and brave bird and is called diˊlɛˊgwa′, "big skunk," because the Cherokee think that is what he says (diˊlɛ, "skunk," and ɛgwa′, "big") (W.W.). The great crested flycatcher, *Myiarchus crinitus boreus*, is called gala′sgaluˋ, in imitation of his cry, gala′s, gala′s (W.W.). James Mooney collected a medicinal formula in which this bird is invoked but did not identify the bird; Olbrechts has identified it as the bittern.[27]

The Cherokee recognize two varieties of phoebe, one the phoebe, *Sayornis phoebe*, the other the wood peewee, *Myiochanes virens*, both of which are called u·lɛˋlada′, "lost." This bird was once a person, who was left behind by his friends and is still wandering around in the woods, calling skˊiˊktidaˋ, "wait for me" (W.W.). The least flycatcher, *Empidonax minimus*, is known as skowaya′ᵏᵃtoˊsti′, "looking for flies" (W.W.).

The bank swallow, *Riparia riparia riparia*, has a proper name, tsoˋyaga′. Will remembered another swallow, now rare, called djɔ·yagagoˋla·nehi′, "swallow, winter lives," which appears to be the rough-winged swallow, *Stelgidopteryx ruficollis serripennis*. The barn swallow, *Hirundo erythrogaster*, is called udiˋgwanᵘzugi′, "notch, crotch, fork" (plural, dzunadiˋgwaᵘzugi′; the "nock" of an arrow is udigwanskwa′, W.W.).

The purple martin, *Progne subis subis*, locally called "black martin," is called tsu·tsu, in imitation of its call (tlu·tlu, Oklahoma form; tjutju, J.T.W.). As far as I could discover, the Cherokee of Qualla Reserve did not put gourds in trees or on poles as nesting boxes for these birds, although Whites and Negroes in many parts of the South do so, and Alexander Wilson, in 1819, noted a similar practice among the

[25] MOONEY, *Myths:* 288–289.

[26] WITTHOFT, *Bird Stories:* 177–178.

[27] MOONEY, JAMES, Manuscript no. 2235 in Bureau of American Ethnology Archives. Mooney and Olbrechts, *Swimmer Manuscript:* 248.

Choctaw and Chickasaw Indians, near neighbors of the Cherokee.[28]

The blue jay, *Cyanocitta cristata*, is named after the sound of its voice, tsas?ᵘga′. The raven, *Corvus corax principalis*, is called kɔlaŋ́, a name with a similar origin. An invisible raven whose voice is heard from the empty sky is believed to represent a transformation of the worst sort of witch, the dread "raven imitator."[29] The raven must once have held an important place in Cherokee tradition, for Timberlake, an early traveler among the Cherokee, noted that the second most important honorary title, "Colona, or the Raven," a "war-title," was conferred on a man who had killed an eagle and returned with its tail.[30] The crow, *Corvus brachyrhynchos*, also has an onomatopoeic name, koga′.

The chickadee, *Parus carolinensis*, is named tc'igalili, in imitation of his call. He is recognized as a friendly bird and often stays near the house and sings. Sometimes, however, he appears suddenly and whispers "tc'ihi, tc'ihi," then flies away, thus announcing that "company is coming," a stranger or someone you haven't seen in a long time. When I first met Will West Long, he claimed that my visit had been foretold by a chickadee. The tufted titmouse, *Baeolophus bicolor*, is called utzugi′, "crest," and is familiar to all Cherokee as "the bird that lies," because of his role in a story. According to Mollie Sequoyah, this bird sometimes foretells a visit in the same way that the chickadee does, but he is lying. Jimsie Wallace also knew this bird by an alternate name, ali·tegidá.

The chickadee and the tufted titmouse play central roles in the story of the Liver Eater, and much of the tradition concerning them centers about several variants of this tale. Cain Screamer's version, which is especially detailed, follows.[31]

Once there was a man among the Cherokee who destroyed people in order to eat their livers. He had a long, hard index finger, which he would thrust into their bodies to extract the liver, and he was able to simulate the appearance of anyone he pleased and thus no one knew when he was around. His unfortunate victims met what they thought was a friend or relative, only to have him take on his own form when they were defenseless, and they died without being able to tell who he was. Once some of the conjurors detected him in his disguise, but he proved invulnerable. He told them, "You can't kill me because you don't know my name. I haven't any end as long as you don't have my name."

A man who was hunting in the woods with his dog killed a deer and made camp for the night. A stranger appeared and ate supper with them. When the man noticed that the stranger was eating the bones along with the meat, he realized who it was and he and the dog slipped off and began to run away as fast as they could. The Liver Eater ran after them and they were forced to hide in a hollow log. He followed their scent to the stump and began to tap the wood with his hard finger. When he came to the opening, the dog kept putting his nose in front of the finger, so that he was unable to find the hollow, and finally gave up and when off. When he appeared at a dance, the dog recognized him and someone asked him, "What is your name?" Without thinking, he answered, "Usti'i'."

The people then began to make plans to kill him. They got all the animals and birds to help them and to keep track of this criminal. Then, when they knew something of his habits, they dug a pitfall on a path which he often followed. He fell into their trap and all of the people, birds, and animals quickly gathered around. He assumed his own shape and began to grab with his long finger at anyone who came too close to the edge of the pit, The people shot arrows at him, but he just brushed them off. They asked the animals how he could be killed. The Tufted Titmouse said, "Shoot him in the head," but the head proved especially tough. They called the Titmouse a liar, and cut out his tongue. Then the Chickadee offered to find his vital spot, and he flew around the monster, avoiding the thrusts of the long finger. Finally this bird came back

[28] BENT, A. C., *Life histories of North American flycatchers, larks, swallows, and their allies.* U. S. Nat. Mus. Bull. 197: 490–491. 1942.

[29] MOONEY, *Myths:* 283–294. 401. MOONEY and OLBRECHTS, *Swimmer Manuscript:* 206.

[30] TIMBERLAKE, *Memoirs:* 71, 81.

[31] For a bibliography of variants of this tale, see: WITTHOFT, *Bird Stories:* 177.

and told the people to shoot him in the hand, just at the base of the long finger. This killed the monster. The people caught the Chickadee, who was a very plain bird, and painted him as a mark of his valor, making him a much prettier bird. The Liver Eater was buried in the pit. Years later some conjurors dug into his grave, and found his finger, which they thought they could use as magical paraphernalia. Suddenly people began to die mysteriously, and so the finger was reinterred and the deaths ceased.

The white-breasted nuthatch, *Sitta carolinensis* (and probably other nuthatches), is called dɑwɑɛyalo'ʰi, "climbing up and down on a round thing" (W.W.; J.T.W. give tuwe·yu'lɔ'ahi'). The brown creeper, *Certhia familiaris americana*, is classified by the Cherokee as a woodpecker and called atɑ'go·luni', "tracking wood."

The house wren, *Troglodytes aedon*, is another bird often seen in the vicinity of Cherokee cabins and is called ganu'la'tsi, which, according to Will, may mean "ribs." The winter wren, *Nannus hiemalis hiemalis*, is called tsi'tsi, in imitation of his note, tsitsitsitsi (W.W.). The Carolina wren, *Thryothorus ludovicianus*, is named ah tama', the name that most of the Cherokee seem to use also for the other wrens. This wren is locally called "rain-bird," and, according to the Cherokee, when it is going to rain he calls for a drink by saying sku'dj'ɑ', sku'dj'ɑ'; when it is going to clear he calls dji·'lɑ', dji·'lɑ', "fire, fire."

The mockingbird, *Mimus polyglottos polyglottos*, is an uncommon bird in the Cherokee locale. According to Will it is called tsuskǫ'.digis'ski', "head eating," because the head of this bird, eaten, is said to make a person clever and intelligent. The catbird, *Dumetella carolinensis*, is called u'zimɑ' (W.W.; utc'imɑ', C.S., J.T.W.), "not smooth." (Sweet corn is also called unitzimɑ' (plural), because the ear does not have a smooth surface like the local Indian varieties.) The brown thrasher, *Toxostoma rufum*, is called wati'yɛ·lɑ', "imitator."

The robin, *Turdus migratorius*, is called tcisgwa'gwa', in imitation of his voice. The wood thrush, *Hylocichla mustelina*, is named kawɔ·'gɑ', probably onomatopoeic, and is commonly known as the "swamp sparrow." Some of my informants tended to use this name for several other birds with which they were not familiar. The bluebird, *Sialia sialis sialis*, is called dsa'gwolɑde?' (W.W.) or djagwo·li' (J.T.W.), both forms referring to his song, which the Cherokee interpret as gwo, gwo, gwo. The blue-gray gnatcatcher, *Polioptila caerulea caerulea*, is called di·si' because he is heard to say di'is, di'is.

The golden-crowned kinglet, *Regulus satrapa satrapa*, is called atsilɑ'.usti'li', "fire on head" (W.W.). The ruby-crowned kinglet has a proper name, t'ɑ'tsala'gɑ', and Will notes that this bird does not winter at Cherokee. The cedar waxwing, *Bombycilla cedrorum*, is called u·nɔ·yi' (C.S. gives a plural, uni·nɔ·yu'), "sand," because it is said that the bird whispers this word, which also describes the soft colors of his plumage. (J.T.W. gives another word for this bird, kanɑs'e'hɔni', which I am unable to analyze.) The vireo, *Vireo olivaceus* and *Vireo griseus*, is called djɑ'tesnali', "stripe on eyes," according to Will; he also includes several warblers under this name. He notes, however, that this bird builds a little hanging nest in the fork of a tree branch.

The warblers represent the most confused family of birds to the Cherokee. Most of the informants recognize few of these birds, and most of the specific names are on the authority of Will West Long. The Wallaces give a generic name for this type of bird, yǫndɑ'gediski'. Cain Screamer refers to them as udo·ni', while the Wallaces use this term for the purple finch and probably several other birds. The best known bird of the group is the yellow-breasted chat, *Icteria virens virens*, known locally as the "yellow nightingale" and called hu'hu' in Cherokee. This bird appears in spring just at plowing time, and there is a popular story about its arrival.[32]

The black-and-white warbler, *Mniotilta varia*, is called djugɑ'tsala'la, "striped on face." Will also tells of a large mythical bird of the same name and appearance,

[32] MOONEY, *Myths:* 288.

which flies only at night and comes down from the mountains to get the sunflower seeds when they ripen. The worm-eating warbler, *Helmitheros vermivorus*, is called kʔi·yu·gi', "chipmunk," because its head is marked like a chipmunk's. The Blackburnian warbler, *Dendroica fusca*, is called ga·naʔgʔi', "falling down to the ground," because, Will says, he dives to the ground if you throw a rock at him. The chestnut-sided warbler, *Dendroica pensylvanica*, is named tuya', which also means "bean." The ovenbird, *Seiurus aurocapillus*, Will calls tsuᵗˢᵘtsɔ·tɔ', "he has a camp." The hooded warbler, *Wilsonia citrina*, is da'ktɛsta'li', "spot on his face." The redstart, *Setophaga ruticilla*, is better known than the smaller warblers and is called awɔ·ha'liyusti', "like an eagle" (also by an abbreviated form of the name, awɔ·ladę"). The water thrush is locally called the "branch bird" (a branch being a small mountain stream), but I could discover no Cherokee name for it. Will could not remember a name for the yellow warbler, *Dendroica aestiva aestiva*, but interpreted its call as go'dada'.

The meadowlark, *Sturnella magna*, is generally called nɔkwisi", "star," from the appearance of its tail in flight, but Will says that it also has a proper name, uni'gwɛlusti'. The orioles, *Icterus galbula* and *Icterus spurius*, are called wɔladɛ, and Will notes that there are two varieties, large and small, and that they build a woven, hanging nest. The grackle, *Quiscalus quiscula*, called blackbird, is known as skwe'lista" (W.W.) (gwalisti', J.T.W.). The red-winged blackbird, *Agelaius phoeniceus*, and the cowbird, *Molothrus ater*, go by the same name but are also specifically referred to by Will as skwe'li·sta" igo·tehi', "grackle living in swamp" (plural, skwe'li·sta" igo·tanehi') and skwelista' sakonage'i', "grackle bluish," respectively. The Wallaces have a special name for the cowbird, sɔ·yida'. The grackle and the redwing are considered the same species by some informants.

The scarlet tanager, *Piranga erythromelas*, and also the summer tanager *Piranga rubra rubra*, are called tso·ʰᵃla (W.W.) (tsʻɔʻᵘli' J.T.W.), a name closely resembling the word for tobacco (tso·la') but seems to have no special significance. The cardinal, *Richmondena cardinalis*, is known merely as "redbird" and named tɔtsu·wa' (tɔdjuwa' is more usual), because it says tɔ'tsu', tɔ'tsu'. One Cherokee myth explains the origin of the redbird from the transformed daughter of the sun.[33] The rose-breasted grosbeak, *Hedymeles ludoviciana*, is known as kaya'skalɛ·na', "big beak" (plural, ditaya'skalɛ·ná; W.W.). The indigo bunting, *Passerina cyanea*, is called ali'tsanoska", "broiling charcoal," an attempt to describe his song, according to Will. The purple finch, *Carpodacus purpureus purpureus*, is not a familiar bird to most Cherokee, but the unusual appearance of this bird has resulted in its name, u'dzo·nɛda', "perfumed," according to Will. The pine siskin, *Spinus pinus pinus*, found in small flocks in these mountains, is named algi·ski, "boiling" (plural, analgi·ski', "they are boiling"), an attempt to describe the unique call of this bird. Will notes that a flock sounds like a boiling pot.

The goldfinch, *Spinus tristis tristis*, usually called golden finch, yellowbird, or flaxbird, is named wad'aga'. This bird is noted for its delicacy, and informants remarked that it was easily caught in thistles, spiderwebs, and similar material. One slightly sticky plant, the Herb Robert, *Robertiella robertiana*, is named wad'aga'dagani'iski", "goldfinch, he catches, grabs." Wataga River, in Tennessee, is probably named for this bird, as was a Cherokee town.[34]

The red crossbill, *Loxia curvirostra pusilla*, is known to few Cherokee, but, according to Big Cove informants, it is resident in the highest zones of the mountains and sometimes comes down to the Cove in October, when it is easily lured to the house-yard by salt. This bird was known as aʰᵃyuga'lǫhi', "twisted mouth" (W.W.), and its head was not eaten.

The towhee, *Pipilo erythrophthalmus*, has an interesting local name, Jori·', but

[33] MOONEY, *Myths*: 245.

[34] BARTRAM, WILLIAM, *Travels through North and South Carolina*: 352, 373. Philadelphia, 1791.

its Cherokee name is tso·wic'g'a'; both names are imitations of the bird's call. The Jori·' is considered a mean little bird who pulls sprouting corn but is said to be exceptionally good to eat. A mountain and a settlement about 12 miles northwest of Franklin, N. C., noted by Bartram in the 1770's, were named Joree, probably as a translation of this Cherokee bird name.[35]

The junco, *Junco hyemalis carolinensis*, known as the snowbird, is called tu·d'i'. (Oklahoma Cherokee form is tluti'; W.W.) The modern Tennessee Cherokee settlement of Snowbird is named for this bird, the town being situated on Snowbird Creek.

Sparrows are known generically as djiskwayᵩ', "really a bird," and only one or two specific sparrows are recognized. The song sparrow, *Melospiza melodia*, is, instead, called ts'ɑk'zo'·wᵃ (according to W.W., the emphatic form is wᵃts'ik'so'wa'), in imitation of its call. Will recognizes two other sparrows: the fox sparrow, *Passerella iliaca iliaca*, called wɔ·ga'ᵩdaⁿ, and the white-throated sparrow, *Zonotrichia albicollis*, tjuniga'tagᵩhi', "marked on each side of face."

Finally, an introduced domestic bird, the chicken, bears a Cherokee name that is as difficult to analyze or interpret as any of the names for native birds: dzatanɑ' (W.W.) or djatagᵩ' (C.S., J.T.W.), which may be only a Cherokee rendering of its English name.

[35] *Ibid.*: 353, 355, 366, 373.

BOTANY.—*On the identity of* Kokonoria.[1] HUI-LIN LI, Soochow University, Soochow, China. (Communicated by EGBERT H. WALKER.)

In a previous number of this JOURNAL,[2] under the title *Kokonoria, a new genus of Plantaginaceae from Tsinghai Province, China*, Dr. Yi-li Keng and Mr. Kwan-hou Keng describe a new genus and species *Kokonoria stolonifera*. The description is in full and is supplemented by detailed drawings of the whole plant and its various parts, as well as a discussion of its relationships, which readily enable one to make out the identity of the plant in question. It is without doubt *Lagotis brachystachya* Maxim. of the Scrophulariaceae.

The authors were correct in doubtfully placing this supposed new genus in the Plantaginaceae. They mentioned its possible relationship with the Scrophulariaceae. In summarizing the characters of the genus, they notice that it is considerably different from most of the Plantaginaceae, saying that "The genus here described is an isolated one [in the Plantaginaceae], differing from the others in having (1) perigynous flowers with an annular disk giving off two lateral accrescent lobes, (2) subsessile anthers with divergent anther sacs, (3) solitary linear ovules pendulous from the tip of the ovary cells, (4) drupaceous fruits with a 2-celled pyrene, and (5) dorsally compressed but not peltate seeds without endosperm." These points are sufficient to warrant the impropriety of including the plant in the Plantaginaceae, but to seek its taxonomic location elsewhere.

Lagotis is usually placed in the Scrophulariaceae, often in the tribe Veroniceae of the subfamily Rhinanthoideae. It has single-seeded cells in the capsule that mark it as one of the most modified of all Scrophulariaceae. Some authors refer it to the tribe Selegineae, which is mainly African. *Lagotis* is primarily an alpine and Arctic Asiatic genus of over 20 species. It extends from Asia Minor through the Himalayas and eastward to Alaska, there extending to the edge of the continental North American glaciation. There are about 12 species in China, in northern Yunnan, Sikang, Tibet, Tsinghai, and Kansu, in the western part of the country. Two species of the genus are stoloniferous, *L. stolonifera* (C. Koch) Maxim. of western Asia and *L. brachystachya* Maxim. of western China. The latter species occurs at altitudes of 2,500–4,300 meters, from Tibet to Tsinghai and Kansu. The

[1] Received September 19, 1946.
[2] Journ. Washington Acad. Sci. 35: 374–378. figs. 1–18. 1945.

Messrs. Kengs' plant, "collected on the exposed bare ground of the steppe, near the ruined city of Ch'a-han-chêng, about 30 miles east of Lake Kokonor, Huan-yüan-hsien, formerly known as Tan-kê-erh, Tsinghai Province, August 10, 1944, by Y. L. Keng and son (no. 5286)," is within the range of *Lagotis brachystachya*.

The synonymy of the plant in question can be adjusted as follows:

Lagotis J. Gaertner, Nov. Comm. Acad. Sci. Petrop. **14**: 533. 1770.
Kokonoria Keng & Keng f., Journ. Washington Acad. Sci. **35**: 374. 1945.
Lagotis brachystachya Maxim. Bull. Acad. Sci. St. Pétersb. **27**: 525. 1883 (Mél. Biol. **11**: 300. 1883).
Kokonoria stolonifera Keng & Keng f., Journ. Washington Acad. Sci. **35**: 375. 1945.

Messrs. Keng, working in the interior of wartime China and without access to extensive library and herbarium facilities, were unfortunately not able to consult needed references freely. They have rendered a good service by giving a very complete description with excellent illustrations and a discussion that make identification possible without the necessity of consulting the type specimens. If all presumably new species and genera could be described with this same degree of thoroughness, taxonomic botany would have fewer uncertain names and less confusion. A description that forces the reader to consult the original specimens has indeed defied its very purpose.

ENTOMOLOGY.—*The genus* Neella *Reuter, with descriptions of four new species* (Hemiptera: Miridae).[1]

TSAI-YU HSIAO, Nankai University, Tientsin, China. (Communicated by ALAN STONE).

In 1907 Reuter established the genus *Neella* (genotype: *Eccritotarsus eucosmus* Stål) including three species, viz., *Sysinas floridulus* Distant, *E. eucosmus* Stål, and *E. mundulus* Stål (Ann. Naturh. Hofmus. Wien **22**: 152–154). Bergroth in 1922 transferred *E. lutescens* Stål to this genus (Ark. för Zool. **14** (22): 17). In 1893 Distant described *E. vultuosus* from Frontera and Teapa, Mexico. I have identified this species from a few specimens collected at Veracruz, Mexico, and consider it as congeneric with *Neella*. From the collection of Neotropical Miridae in the U. S. National Museum I have discovered four more new species, which are described below.

This genus is very close to *Tenthecoris* Scott, but the body is more elongate, with costal margins of hemelytra nearly parallel, vertex flat or somewhat concave. The rostrum is long with short but not distinctly thickened third and fourth segments. There is no sexual dimorphism as in *Neoneella* Costa-Lima, and the cuneus of female is usually shorter in *Neella* than in *Neoneella*.

[1] Received August 28, 1946.

KEY TO SPECIES OF NEELLA

1. Hemelytra entirely fuscous (except the extreme base) 2
   Hemelytra not entirely fuscous 4
2. Pronotum entirely reddish or yellowish, legs entirely pale, hemelytra explanate posteriorly ..... *eucosmus* (Stål)
   Pronotum fuscous or partly fuscous, legs with at least posterior tibia fuscous or partly fuscous, hemelytra not explanate posteriorly 3
3. Head, pronotal collar, and calli red, antennal segments III and IV pale ..... *mundula* (Stål)
   Pronotal collar and calli fuscous, head also tinged with fuscous; antennal segments III and IV dark ..... *vultuosa* (Dist.), n. comb.
4. Hemelytra unicolorously rufous or flavous 5
   Hemelytra red and dark 6
5. Antennal segment I entirely pale, vertex flat, rostrum reaching apex of intermediate coxae, posterior tarsi pale ..... *unicolor*, n. sp.
   Antennal segment I dark, vertex somewhat concave, rostrum reaching apex of posterior coxae, posterior tarsi fuscous. *lutescens* (Stål)
6. Pronotum without a broad transverse dark band on posterior disk 7
   Pronotum with a broad transverse dark band on posterior disk 8
7. Pronotal disk uniformly red, anterior and intermediate tibia each with apex fuscous, ninth abdominal segment concolorous. *floridula* (Dist.)
   Pronotal disk with a large median fuscous area

reaching posterior margin, anterior and intermediate tibiae unicolorous, ninth abdominal segment fuscous.....*bicolor*, n. sp.

8. Pronotal collar fuscous; dark band on pronotum broad, occupying nearly whole disk; anterior and intermediate tibiae fuscous at apex.....*carvalhoi*, n. sp.

Pronotal collar pale; dark band on pronotum narrow, occupying only anterior half of disk; anterior and intermediate tibiae unicolorous.....*fasciata*, n. sp.

Neella bicolor, n. sp.

Coloration and size similar to that of *N. floridula* (Distant) but with distinct dark area on pronotum, anterior and intermediate tibiae not darkened at apex, posterior tibia with nearly apical half dark, and with ninth abdominal segment dark. Antennal segment II longer and slightly thickened apically. Male genitalia distinct.

Male.—Body oblong, length 4.95 mm, width 2.15 mm, reddish ochraceous with fuscous, color on head, calli, and underside of the body paler; clothed with fine golden simple hairs.

Head vertical, width across eyes 1.16 mm, length seen from above 0.39 mm, height seen from side 0.86 mm; vertex flat, width 0.65 mm. Eyes large, seen from above occupying nearly the whole length of head, divergent posteriorly; frons vertical, slightly convex; clypeus not prominent, slightly curved posteriorly toward apex. Rostrum nearly reaching apex of intermediate coxae, length of segments I:II:III :IV::0.52 mm:0.21 mm:0.21 mm, joint between III and IV indistinct.

Antennae reddish fuscous, length of segment I, 0.56 mm, II, 1.06 mm (segments III and IV missing) (length of antennal segments in the paratype I:II:III:IV::0.56 mm:1.06 mm :38 mm: 0.49 mm, III and IV luteous).

Pronotum, length 0.9 mm, width at base 1.55 mm, at apex 0.77 mm; collar distinctly thicker than antennal segment I; calli transversely rectangular, separated by a deep rounded impression in the middle, their posterior margin not reaching side of pronotum but ended in a deep impression on each side inside lateral margin of pronotum; posterior margin of pronotum slightly concave before scutellum, lateral margins sinuate at middle, humeral angle round, posterior disk finely but distinctly punctate, with a large fuscous spot occupying about the middle third and reaching posterior margin. Scutellum fuscous, width 0.77 mm, length 0.56 mm, triangular, with a distinct broad impression at middle of base.

Hemelytra with embolium linear, slightly convex posteriorly, length of embolium 2.28 mm, inner half of corium, clavus (except basal fifth), and inner angle of cuneus fuscous; cuneus declivent, width 0.86 mm, length 0.9 mm, membrane fuscous, finely rugulose.

The ninth abdominal segment and male genital parameres fuscous; male genitalia with left paramere bent sharply at basal third, basal portion ovate, apical portion much slenderer and pointed at apex; right paramere broad, curvate, tapering and pointed at apex. Legs moderately long, length of posterior femur 1.5 mm, length of posterior tibia 1.63 mm, apical half of posterior tibia fuscous, all tarsi pale.

Types.—U.S.N.M. no. 58082, holotype male, Porto Bello, Panama, March 1, 1911 (E. A. Schwarz); paratype, male, locality and collector same as holotype, March 12, 1911.

Neella carvalhoi, n. sp.

Female.—Body oblong, length 5.03 mm, width 2.02 mm, ochraceous with fuscous, clothed with fine simple flavous hairs.

Head vertical, width across eyes 1.08 mm, length seen from above 0.39 mm, height seen from side 0.86 mm; vertex flat, width 0.56 mm. Rostrum barely reaching apex of posterior coxae, length 1.82 mm, length of segment I 0.52 mm, II 0.91 mm, joint between III and IV indistinct.

Antennae reddish fuscous, length of segment I 0.46 mm, II 1.04 mm, III and IV missing.

Pronotum impunctate, length 0.86 mm, width at base 1.51 mm, at apex 0.69 mm, posterior disk and collar fuscous, extreme humeral angle pale. Scutellum fuscous, triangular, width 0.73 mm, length 0.52 mm, basal impression much broader than that of *bicolor*, n. sp.

Hemelytra with coloration similar to that of *bicolor*, n. sp., emboliar margin very slightly convex, linear, length 2.58 mm; cuneus width 0.77 mm, length 1.03 mm, membrane fuscous.

Legs moderate in length, posterior femur 1.72 mm, posterior tibia 1.94 mm long; apical third of anterior tibia and sometimes extreme apex of intermediate tibia fuscous.

Male.—Color pattern similar to female,

width of head seen from above 1.19 mm, width of vertex 0.49 mm; length of antennal segment I 0.49 mm, II 1.19 mm. Genitalia similar to *bicolor*, n. sp., but the right paramere narrower and much longer and more twisted.

Types.—U.S.N.M. no. 58083, holotype, female, Trinidad River, Panama, June 10, 1912 (A. Busck); allotype, male, San José, Costa Rica (M. Valerio); paratype, female, same data as allotype.

This species is named in honor of Dr. José Candido M. Carvalho, who is energetically expanding our knowledge of the Neotropical Miridae.

Neella fasciata, n. sp.

Male.—Body elongate, length 4.9 mm, width 2.15 mm, ochraceous with reddish and fuscous, clothed with yellow simple hairs.

Head broad, vertical, width across eyes 1.29 mm, length seen from above 0.35 mm, height seen from side 0.78 mm; vertex somewhat excavate, width 0.56 mm, more yellowish posteriorly; frons tinged with reddish, flat; clypeus and jugum red, the former not prominent, discrete from frons on a line connecting lower ends of eyes. Eyes large, prominent, greatly projecting over the pronotal collar. Rostrum yellowish, with extreme apex fuscous, reaching apex of posterior coxae, length of segments I:II:III:IV::0.56 mm:0.63 mm:0.22 mm :0.18 mm (joint between II and III indistinct).

Antennae inserted at lower third of inner margin of eye, linear, length of segments I :II:III:IV::0.56 mm:1.25 mm:0.49 mm:0.69 mm, I and II brownish red, III and IV yellow, much slenderer than I and II, II very slightly thickened toward apex.

Pronotum yellow, with a transverse fuscous band behind calli extending to across propleura; length 0.9 mm, width at base 1.63 mm, width at apex behind collar 0.99 mm, apical collar very distinct, a little thicker than antennal segment I; posterior margin slightly sinuate before scutellum, lateral margin distinctly sinuate, humeral angle rounded, disk with punctures at base of hairs. Scutellum fuscous except base, triangular, width 0.77 mm, length 0.65 mm, impressed at middle of base.

Hemelytra reddish, with costal margins nearly parallel; embolium linear, length 2.37 mm; inner angle of corium broadly, clavus excepting basal fourth, and inner angle of cuneus fuscous, length of cuneus 0.86 mm, width 0.9 mm, membrane fuscous.

Body beneath yellow. Legs moderately long, concolorous, length of posterior femur 1.72 mm, of posterior tibia 1.98 mm. Male genitalia with left paramere sharply bent at basal third, much enlarged at base and tapering toward apex; right paramere broad and rounded at apex.

Female.—Similar to male in coloration, length 5.59 mm, width 2.15 mm. Head with width across eyes 0.86 mm, width of vertex 0.34 mm. Length of antennal segments I:II :III:IV::0.53 mm:1.26 mm:0.49 mm:0.63 mm.

Types.—U.S.N.M. no. 58084, holotype, male, Barro Colorado Island, Canal Zone, October 9, 1940, collected at light (J. Zetek, no. 4691); allotype, female, Barro Colorado Gatun Lake, Panama, August 1923 (R. C. Shannon); paratypes, male, Trinidad River, Panama, May 2, 1911 (A. Busck); female, Porto Bello, Panama, April 21, 1912 (A. Busck); female, Piedras Negras, Costa Rica (Schild-Burgdorf).

Neella unicolor, n. sp.

Female.—Body oblong, uniformly ochraceous except the fuscous antennal segments II and IV and the pale membrane on hemelytra, clothed with concolorous simple hairs; length 4.99 mm, width 2.15 mm.

Head vertical, width across eyes 1.2 mm, length seen from above 0.43 mm, height seen from side 0.73 mm; vertex flat, width 0.56 mm; frons convex; clypeus evenly curved posteriorly. Rostrum reaching apex of intermediate coxae.

Antennae slender, linear, length of segments I:II:III:IV::0.41 mm:1.09 mm:0.55 mm :0.49 mm.

Types.—U.S.N.M. no. 58085, holotype, female, Yurimaguas, Peru, April 7, 1920 (H. S. Parish); paratype, female, Iquitos, Peru, May 5, 1920 (H. S. Parish).

ORNITHOLOGY.—*Three new North American birds.*[1]

HARRY C. OBERHOLSER, Cleveland Museum of Natural History.

In the course of the writer's researches on the birds of Texas, a number of new races of North American birds were discovered. Three of these are described below.

Anthus spinoletta geophilus, n. subsp.

ALASKA PIPIT

Subspecific characters.—Similar to *Anthus spinoletta alticola* Todd, but upper parts somewhat darker, less grayish (more brownish); lower surface paler or more whitish and more buffy (less cinnamomeous); jugulum usually heavily streaked with dark brown.

Measurements (in mm).—*Adult male:* Wing, 78–87 (average, 83.8); tail, 62.5–69 (65); exposed culmen, 11–12 (11.8); tarsus, 21.5–23 (22.3); middle toe without claw, 13–14.3 (13.8); white on inner web of outermost tail feather, 33.5–40 (37.8). *Adult female:* Wing, 75.5–83.5 (average, 78.8); tail, 58–64 (61.3); exposed culmen, 11.5–12 (11.8); tarsus, 20–22 (21.3); middle toe without claw, 12.3–14 (13); white on inner web of outermost tail feather, 29.5–38.5 (33.8).

Type.—Adult male, no. 298525, U. S. National Museum, Biological Surveys Collection; False Pass, Unimak Island, Alaska; May 14, 1925; O. J. Murie; original number, 2950.

Geographic distribution.—Breeds in southwestern Alaska. Winters south to southern Mexico. Casual east to New York, Pennsylvania, and the District of Columbia.

Amphispiza nevadensis campicola, n. subsp.

IDAHO SAGE SPARROW

Subspecific characters.—Similar to *Amphispiza nevadensis nevadensis* but somewhat larger; upper parts darker, more grayish (less ochraceous or buffy); and the flanks also more grayish (less buffy).

Measurements (in mm).—*Adult male:* Wing, 76.5–82 (average, 79.3); tail, 69.5–77 (72.8); exposed culmen, 9.5–11.5 (10.8); tarsus, 20–23 (21.8); middle toe without claw, 12.5–14 (13.5). *Adult female:* Wing, 70.5–78 (73.5); tail, 68–74 (70); exposed culmen, 9.3–10.5 (10); tarsus, 19.8–20.5 (20.3); middle toe without claw, 12.5–14 (13.3).

Type.—Adult male, No. 34892, Cleveland Museum of Natural History; 6 miles south of Hamer, Jefferson County, Idaho; May 16, 1931; Pierce Brodkorb; original number, 6940.

Geographic distribution.—Breeds north to middle Idaho and eastern Washington; west to eastern Washington and central northern Oregon; south to southeast central Oregon and southern Idaho; and east to southern and central Idaho. Winters south to southern California, southern Arizona, and Chihuahua.

Passerella iliaca zaboria, n. subsp.

ALASKA FOX SPARROW

Subspecific characters.—Resembling *Passerella iliaca iliaca,* from eastern North America, but upper parts including wings and tail averaging darker and much more grayish or sooty (less rufescent), the reddish brown spots usually smaller, less numerous, and decidedly duller; markings on the under surface duller, less rufescent (darker, more blackish).

Measurements (in mm).—*Adult male:* Wing, 87–91.8 (average, 88.8); tail 71–77.3 (74.3); bill (exposed culmen), 11–13 (11.8); height of bill at base, 7.8–9 (8.3); tarsus, 24.3–25.4 (24.8); middle toe without claw, 15–17 (15.8). *Adult female:* Wing, 81–86.5 (83); tail, 67–71 (69.3); bill (exposed culmen), 11–12 (11.5); height of bill at base, 7.5–8.7 (8.3); tarsus, 23.3–26 (24.8); middle toe without claw, 14–16 (14.8).

Type.—Adult male, no. 187118, U. S. National Museum, Biological Surveys collection; Circle, Alaska; July 4, 1903; Ned Hollister; original number, 240.

Geographic distribution.—Breeds north to northern Manitoba, Mackenzie, and Alaska; west to Alaska and Alberta; south to Alberta and Manitoba; and east to Hudson Bay. Winters south to Texas, Louisiana, and Florida.

Remarks.—The fox sparrow was originally described[2] without more definite type locality

[1] Received August 29, 1946.

[2] *Fringilla iliaca* Merrem, Avium Rar. Icones et Descript., pt. 2, p. 37, pl. [X]. 1786.

than North America. Since the colored plate and the description seem to indicate that they were derived from a specimen of this species from eastern North America, the name is hereby restricted to the eastern fox sparrow from Quebec. As there is no name available for the western race, it is here named as above.

ORNITHOLOGY.—*A new subspecies of tanager from northeastern Colombia.*[1]

JOHN T. ZIMMER, American Museum of Natural History. (Communicated by HERBERT FRIEDMANN.)

Among other interesting material received from Brother Nicéforo María of the Instituto de La Salle, Bogotá, Colombia, are four specimens of the tanager *Chlorospingus ophthalmicus* that can not be referred to any of the known forms. Since they are consistently different, it is apparent that they represent an undescribed subspecies which is described below.

I am grateful to Brother Nicéforo María for the opportunity to examine and describe this interesting bird and to retain the type in the American Museum of Natural History. I am further grateful to William H. Phelps, of Caracas, Venezuela, for the loan of the type of one of the allied forms, and to the Chicago Natural History Museum for permission to examine important critical material in that institution.

In the following description, names of colors are capitalized when direct comparison has been made with Ridgway's *Color standards and color nomenclature.*

Chlorospingus ophthalmicus eminens, n. subsp.

Type.—From Gramalote, Department of Norte de Santander, Colombia. Amer. Mus. Nat. Hist. no. 748393. Adult female collected in November 1940 [by Brother Nicéforo María].

Diagnosis.—Distinguishable from all the known subspecies of *C. ophthalmicus* by its deep black head, darker than in any of the other forms. In most details it resembles *C. o. nigriceps* of central Colombia, but it has a strong white postocular area lacking in that form; auriculars are no blacker than the top of the head; the throat is less heavily spotted. From *jacqueti* of the Caracas region of Venezuela it is distinguishable by its paler (more whitish) and somewhat more heavily spotted throat, darker green back, and more grayish belly, and by having the auriculars no darker than the crown. From *venezuelanus* of the Mérida region it is separable by its darker cap, paler and less heavily spotted throat, lighter yellow breast, and grayer belly; from *falconensis* of the State of Falcón, Venezuela, it differs by its much paler throat, less olive-green back, paler yellow breast without any brown coloration centrally, grayer belly, and absence of bright brown on the auricular region.

Range.—Known only from the type locality and Páramo de Tamá, Venezuela.

Description of type.—Top of head black without a positive brownish tone; upper malar region and most of auriculars similarly black but with an inconspicuous grayish area on the upper and posterior auricular feathers, separating the malar region from the occiput; loral region dull whitish with black tips; a prominent white stripe extending from near the upper anterior corner of the orbit posteriorly to a point above the middle of the auriculars and broadening behind the eye to involve part of the feathering of the lower eyelid. Back Warbler Green×Olive Green (with dusky subterminal stripes on some of the feathers, not shown by any of the paratypes); upper tail-coverts slightly lighter. Chin and throat whitish, with a slight buffy tinge, strongest on the malar region, and with only moderately prominent dusky tips on the feathers, obsolete on the throat and the posterior malar area; between the throat and the malar region the dark tips are lengthened so as to produce a narrow dark line. Breast Wax Yellow, darkening to Pyrite Yellow on the sides and flanks; belly with light gray centers and white margins, giving a distinctly grayish tone to the region; under tail-coverts with Yellowish Citrine centers and narrow Stron-

[1] Received September 3, 1946.

tian Yellow margins. Wings sooty, with the outer margins of the remiges narrowly green like the back except on the outer primary and the terminal two-fifths of the next three primaries where the edges are light gray; inner margins of the remiges whitish; under wing-coverts pale yellow; bend of wing deeper yellow. Tail sooty, with exposed surfaces about like the back. Bill (in dried skin) black; feet pale brownish. Wing, 74 mm; tail, 60.5; exposed culmen, 11; culmen from base, 14.5; tarsus, 20.5.

Remarks.—Sexes alike. Three other skins from the type locality (one male, one female, and one bird of undetermined sex) show no decided differences from the type. The bird without given sex has the breast very slightly paler than that of the type; the other two have this area slightly deeper. In all, however, the white post-ocular marking is equally prominent, the top of the head is notably blackish, the belly is grayish, and the throat is only lightly buffy and moderately spotted—all characters of *eminens* in this combination. A male from Páramo de Tamá, Venezuela, agrees in essential details.

I am unable to understand the statement by the late Mr. Underdown [Ibis (13) 2: 651. 1932] that *venezuelanus* of the Mérida region is the darkest-headed subspecies of this group. In the series at hand, *venezuelanus* is exceeded by *nigriceps* of central Colombia as well as by the present form. There might be some suspicion that the specimens of *venezuelanus* now before me had faded sufficiently to reduce the color of the crown to the distinctly brownish hue they now exhibit in that region—a color that is matched by that of the auriculars as it is in *eminens*. However, the throat in *venezuelanus*, though more exposed and more likely to fade than the crown, is deeper in color than in *eminens*, as well as more heavily spotted—characters that are as useful as the hue of the crown in separating these two forms.

Hellmayr [Publ. Field Mus. Nat. Hist., zool. ser., 13 (pt. 9): 403. 1936] has included a locality in the Department of Santander, Colombia, in the range of *jacqueti*, the Caracas form. In view of the existence of the present form and *venezuelanus* in the terrain between Santander and the State of Lara, this record is surprising. The specimens from Santander, however, I find it impossible to distinguish from Trujillo skins of *jacqueti*.

Specimens examined.—*C. o. jacqueti:* VENEZUELA: Cumbre de Valencia, 3 ♂, 2 ♀; Galipán, 3 ♂, 4 ♀; Silla de Caracas, 1 ♂, 1 ♀; Colonia Tovar, 3 ♂, 2 ♀; head of Chichiriwichi Valley, 1 (?); El Limón, Puerto La Cruz, 1 ♂, 1 ♀; Caripe, 4 (?); Bucarito, Tocuyo, 2 (?); Guamito, Trujillo, 1 ♂[2], 1 ♀[2].

C. o. venezuelanus: VENEZUELA: "Mérida," 4 (?); Escorial, 2 ♂; Valle, 2 ♂, 1 ♀; El Loro, 1 (?); Hechicera, 1 (?); Conejos, 1 ♂; Montañas Sierra, 1 ♂.

C. o. falconensis: VENEZUELA: San Luis Mountains, Falcón, 1 ♂ (type)[3]; Curimagua, Falcón, 1 ♀.

C. o. nigriceps: COLOMBIA: Río Toche, 1 ♂; Santa Elena, 3 ♂, 3 ♀, 1 (?); La Candela, 1 ♂; Sabanalarga, 1 (?); El Eden, 1 ♂; Medellín, 1 (?).

C. o. eminens: COLOMBIA: Gramalote, Norte de Santander, 1 ♀ (type), 1 ♂[4], 1 ♀[4], 1 (?).[4] VENEZUELA: Páramo de Tamá, 1 ♂.[2]

[2] Specimens in Chicago Natural History Museum.
[3] Specimen in collection of W. H. Phelps, Caracas.
[4] Specimens in Instituto de La Salle, Bogotá, Colombia.

ORNITHOLOGY.—*Two new hemipodes from southeastern Asia.*[1] H. G. DEIGNAN, U. S. National Museum. (Communicated by HERBERT FRIEDMANN.)

I

A series of 27 specimens of *Turnix suscitator* from central and northern Siam are sufficiently distinct from the races of neighboring areas to justify the establishment of a new form, which I propose to name—

Turnix suscitator thai, n. subsp.

Type.—Adult female, U.S.N.M. no. 332637, collected at Nong (*or* Bung) Boraphet, central Siam (at lat. 15° 43′ N., long. 100° 14′ E.),

[1] Published with permission of the Secretary of the Smithsonian Institution. Received September 30, 1946.

on March 24, 1933, by Hugh McCormick Smith (original number 6195).

Diagnosis.—The new race is, *in series*, easily distinguished from all others of the species by having the prevailing tone of the upperparts *brownish gray*, rather than grayish brown (as in *atrogularis*) or rufous (as in *blakistoni*). It has the bill intermediate in robustness between those of *atrogularis* (Malay Peninsula) and *blakistoni* (southeastern China) and about equal to that of *plumbipes* (Assam).

Range.—Central Siam, south at least to Prachuap Khirikhan (Ko Lak); northwestern Siam.

Remarks.—Birds from Prachuap Khirkhan agree in color with topotypes but have the heavy bill of *atrogularis;* one specimen from the type locality and one from Chiang Mai likewise possess an exceptionally heavy bill.

Examples seen from northwestern Siam average slightly browner than those from Central Siam; it is suggested, however, that this difference would disappear with more material, since Robinson and Stuart Baker, in describing *interrumpens* (Bull. Brit. Orn. Club *48*: 60, 1928) observed that "specimens from N.E. Siam are very gray, and with further material may have to be separated and named." Moreover, a single female from Myitkyina agrees perfectly with certain Siamese birds; thus it seems likely that the name *thai* must be used even for the populations of the Shan States and northeastern Burma.

I have not been able to separate *interrumpens*, the putative form of peninsular Siam, from *atrogularis* of the southern Malay States and northernmost Sumatra. *T. s. interrumpens* was described as being "very uniform in the colour of its upper plumage, having neither the rich red marking of *blakistoni* nor the velvety-black bars and marks of *T. s. suscitator* or *T. s. atrogularis.*" Twelve peninsular Siamese birds before me have the general color of the upperparts grayish brown (as in *plumbipes* and *atrogularis*) and the black markings as strongly present on the average as in any other race.

Of five examples seen from southern Annam, four agree well enough with *thai;* the fifth, a winter-taken female, has the coloration of *blakistoni*, but a much heavier bill, and, in fact, is not too different from a uniquely rufescent specimen of *thai* taken at Chiang Mai.

II

The populations of *Turnix suscitator* found in Java and Sumatra (except Achin) are trenchantly divided from those of Achin and the Asiatic mainland by having the *massive* bill yellow instead of plumbeous, and a well-marked rufous nuchal collar in the adult female. My material indicates that Sumatran birds are not correctly placed under the name *suscitator* (Java), and for them I suggest the name—

Turnix suscitator machetes, n. subsp.

Type.—Adult female, U.S.N.M. no. 181157, collected on the Siak River, east-central Sumatra, on December 20, 1906, by William Louis Abbott.

Diagnosis.—Nearest *T. s. suscitator* but readily separated from it, *in series*, by having the nuchal collar and the ground color of the remaining upperparts distinctly darker in tone.

Range.—Sumatra (except Achin and perhaps the southernmost parts); Bangka; Bilitong.

Remarks.—In this race, as in all others of the species, a single specimen *may* match individual examples of one or more other forms; the distinctions between subspecies are obvious, however, when respectable series are compared.

For the loan of comparative material from several critical areas, my thanks are due the authorities of the Academy of Natural Sciences of Philadelphia and of the American Museum of Natural History.

HERPETOLOGY.—*A subspecies of the lizard* Xantusia riversiana.[1] HOBART M. SMITH, A. and M. College, College Station, Tex. (Communicated by HERBERT FRIEDMANN.)

Specimens of *Xantusia riversiana* illustrated by Van Denburgh (Occ. Pap. California Acad. Sci. 10: pl. 51. 1922) and by Smith (Handb. Lizards: pls. 89, 90. 1946) indicate a difference in pattern between topotypic material from San Nicolas Island and that from Santa Barbara and San Clemente Islands.

These islands, with Santa Catalina, form a semicircular group of four off the coast of southern California. They comprise the southern group of the Santa Barbara Islands. Santa Catalina is nearest the mainland (20 miles) and is slightly the largest. The southernmost, San Clemente, lies 25 miles south of Santa Catalina and is but little smaller than the latter. The others lie to the west of Santa Catalina; Santa Barbara, a very small island, is about 25 miles due west, and San Nicolas, of intermediate size, is about 35 miles southwest of the latter.

Oddly enough, the species is not known from Santa Catalina Island, although it occurs on all the others and is restricted to them. Santa Catalina is inhabited by some three mainland forms of lizards, possibly four of snakes, and two of amphibians. Only *Xantusia* occurs on the other islands, except on San Clemente where *Uta stansburiana* is recorded. Presence of king snakes possibly accounts for the absence of *Xantusia* on Santa Catalina Island. Regardless of the reason for the absence of *Xantusia*, there is no question that Santa Catalina is markedly different faunistically from the other islands, which have a nearly uniform and almost totally impoverished fauna.

Isolated as are these islands, apparently long distinct from the mainland, it is not surprising that animals in them show some differentiation. It is not improbable that the population of *Uta stansburiana* on San Clemente has differentiated to some degree. Certainly *Xantusia* has done so. The only endemic form recognized at present on any island of the southern group is *Batrachoseps attenuatus catalinae* on Santa Catalina Island. One other, *Xantusia riversiana*, is endemic to the group as a whole. *B. a. pacificus*, restricted otherwise to the northern group of the Santa Barbara Islands (San Miguel, Santa Rosa, Santa Cruz, Ana Capa) has been suggested to occur on Santa Barbara Island by Bishop (Handb. Salamanders: 323. 1943), but this seems very dubious in view of the completely different faunas of the northern and southern groups of these islands (they share only two—*Hyla regilla* and *Uta stansburiana*—in the total of 15 forms, eight others in the southern and five others in the northern group occurring in the entire group). If Bishop's suggestion proves correct it is probable that the name should apply to *B. a. catalinae*.

Specimens available at the present time include one *X. riversiana* from San Clemente Island and three from San Nicolas Island.[2] These differ from one another in at least four respects not obviously subject to individual variation within the total limits observed; it is assumed that further specimens will prove the relative constancy of at least some if not all the differences discerned. Unfortunately, material from Santa Barbara Island is not readily available to me; there is little question, however, that it too will prove to be somewhat different from the topotypes.

It is suggested that the population on San Clemente Island be known as—

Xantusia riversiana reticulata, n. subsp.

Holotype.—U. S. Fish and Wildlife Service no. 9228, collected on San Clemente Island in the summer of 1940; received from C. W. Kern.

Diagnosis.—Similar to *Xantusia riversiana riversiana* of San Nicolas Island except: preanals irregular, smaller; gulars nearly uniform,

[1] Received September 3, 1946.

[2] I am indebted to Francis M. Uhler for the privilege of studying these specimens.

scarcely enlarged medially; pregular fold poorly developed; dorsal head scales exceedingly pitted, corrugated, broken up; dorsolateral light line not evident; dorsal surfaces, including those of legs, boldly reticulated or spotted with black.

Description of holotype.—Dorsal head scales normal, except exceedingly pitted and corrugated, rendering the sutures well-nigh indiscernible; central gulars between the anterior and posterior pregular folds small, 24 from rear of former and front of latter; anterior pregular fold poorly defined, with no more than one or two rows of small scales; largest preanals scarcely wider than widest abdominal plates; preanals not clearly in two rows. No evidence of a dorsolateral light streak; back covered with clear-cut, dark marks, which effect a reticulated pattern; limbs and head reticulated and spotted; tail irregularly lined and spotted above; belly and sides of throat with rather numerous small black flecks.

The holotype is illustrated on plate 90 of the *Handbook of lizards of the United States* (Smith, 1946).

Comparisons.—In the three topotypic *X. r. riversiana* the sutures between the dorsal head scales are clearly apparent, although some pits are present. The central gulars are somewhat enlarged: a longitudinal count of 20 or 21 is obtained from the rear of the anterior pregular fold to the front of the posterior. The anterior pregular fold is well defined and contains three or four rows of small scales. The largest preanals are as wide as two adjacent, small abdominals, and nearly twice as wide as any one of the widest abdominals. The preanals are clearly in two longitudinal rows. All show evidence of a dorsolateral light streak on each side (see pl. 89, Handb. Lizards. 1946); those in which the light lines are less evident have less distinct dark markings. The legs are dimly marked. The belly and sides of the gular region are not or sparsely marked.

Remarks.—In pattern *X. r. reticulata* resembles to some extent the specimen illustrated by Van Denburgh (op. cit.: pl. 51, fig. 2) from Santa Barbara Island. The two populations may be consubspecific.

ICHTHYOLOGY.—*Systematics of an American atherine fish,* Melanorhinus microps (*Poey*).[1] CARL L. HUBBS and LUIS R. RIVAS. (Communicated by LEONARD P. SCHULTZ.)

Among the most distinctive of the many New World Atherinidae are the species that have been referred to *Melanorhinus* and to *Mugilops*. Although it was evident for several years, the conclusion that *Mugilops* Meek and Hildebrand (1923, p. 271) is a synonym of *Melanorhinus* Metzelaar (1919, p. 38) was first published by Myers and Wade (1942, p. 139).

Two species of *Melanorhinus*, both Tropical, are currently recognized, namely *M. cyanellus* (Meek and Hildebrand) of the Pacific and *M. boekei* Metzelaar of the Atlantic. The Pacific representative was treated in detail by Meek and Hildebrand (1923, pp. 271–272, pl. 22, fig. 1), by Myers and Wade (1942, pp. 139–141), and by Fowler (1944, pp. 219–220, 244, 408, 497, fig. 132). Myers and Wade recognized *Mugilops marinus* Meek and Hildebrand as a synonym of *Melanorhinus boekei* Metzelaar. In preparing a supplementary treatise on the marine fishes of Panama, Hildebrand (personal communication) has concurred in this opinion. We now find that the Atlantic species was named much earlier, as *Atherina microps*, by Poey. The synonymy of *Melanorhinus microps* follows.

Melanorhinus microps (Poey)

Atherina microps Poey, 1860, p. 266 (original description; locality not specified, but presumably Habana, Cuba).—Jordan, 1887, p. 571 (West Indies).—Jordan and Evermann, 1896, pp. 789, 791–792 (comparisons; description, after Poey; Havana).—Jordan and Hubbs, 1919, pp. 48–49 (referred to

[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 289. Received September 16, 1946. The study was conducted at the United States National Museum, where research facilities were made freely available. The junior author is studying under a John Simon Guggenheim fellowship.

Atherinopsinae, but of undetermined genus).—Jordan, Evermann, and Clark, 1930, p. 246 (Habana).

Melanorhinus boekei Metzelaar, 1919, p. 38, fig. 14 (original description; "oysterpond at St. Martin").—Jordan, Evermann, and Clark, 1930, p. 249 (reference).—Myers and Wade, 1942, pp. 139, 141 (generic position; genotype; synonymy; dorsal spines).

Mugilops marinus Meek and Hildebrand, 1923, pp. 271–272, pl. 22, fig. 2 (comparison; original description; Porto Bello, Panama).

Mugilops marina Jordan, Evermann, and Clark, 1930, p. 252 (reference; "Panama Bay" wrongly given as range and "Porto Bello, Panama Bay" wrongly located as the type locality).

Melanorhinus marinus Fowler, 1944, p. 462 (reference—*M. boekei* overlooked).

Although Jordan and Hubbs indicated in 1919 that it appears to be referable to the New World subfamily Atherinopsinae, *Atherina microps* has remained an unplaced enigma. Now it becomes evident to what genus and species it should be referred. Fortunately, though brief, Poey's description covers a number of crucial characters. In these as in other respects the diagnosis agrees acceptably with the Atlantic species of *Melanorhinus*. The agreement will be appreciated by one who compares with recent descriptions or with specimens of that species the following free rendering of Poey's diagnosis of *Atherina microps:* The small head is contained 5 times in the total length. The body is deep—somewhat deeper than the head is long. The eye is small, 4 in the head length. The mouth is much smaller than in "*Atherina laticeps*" [*Atherinomorus stipes*] and is very protractile. The first dorsal is more anterior than it is in "*A. laticeps.*" The second dorsal and the anal are longer than in that species. The ray formula is "D. 5–1, 15; A. 1, 19." The anus is close to the anal fin. Color is silvery, with the back greenish and the scales partly dotted with brown. The head is rather deep blue and the lateral band is not sharply defined.

The only species to which this diagnosis applies is the one currently called *Melanorhinus boekei*. As Jordan and Hubbs noted, the many-rayed anal fin and the location of the anus close to the anal fin preclude an identification with any of the few American species of Atherininae (recently treated by Hubbs, 1944b). The deep body, the many-rayed second dorsal fin, and the lack of a sharp lateral band confirm this view. All known Atherinopsinae other than the species of *Melanorhinus* are likewise excluded from consideration by the lack of a well-defined silvery band. The dorsal ray formula is also unlike that of any atherinopsine other than *Melanorhinus*. Only that genus and *Notocheirus* Clark (1937, p. 88) have as many as 15 dorsal soft-rays and *Notocheirus* has no spinous dorsal. Other features of form, proportions, and color apply to *Melanorhinus*. Identification with the Atlantic species of that genus is made on the basis of locality, general agreement in all characters and, specifically, the low number of spines in the first dorsal fin (Table 1). The Pacific species, *M. cyanellus*, has 8 or 9 spines in this fin, according to Meek and Hildebrand (1923, p. 272) and Fowler (1944, p. 220).

The only discrepancies between Poey's diagnosis of *Atherina microps* and other descriptions and specimens of the Atlantic *Melanorhinus* are in the number of dorsal spines and of anal soft-rays (Table 1). There may be regional variations in ray number, but since the rays are very small and closely crowded, it is more plausible to assume that Poey, who probably used only a hand lens, made too low a count. Rather high power with good illumination is required for reliable counting.

The approximate variation in ray counts in *Melanorhinus microps* has been determined by counting a series of 28 specimens in the United States National Museum (no. 9432). Though the locality is indeterminable, the identification of this set seems to be assured on the basis of the number of dorsal spines and of the other diagnostic features that were pointed out by Meek and Hildebrand (1923, p. 271). The body depth measures 3.4 to 3.8 times in the standard length (36 to 56 mm). The distance from the caudal base to the dorsal origin when stepped forward usually extends to the tip of the snout or a pupil's length farther forward, rarely almost an eye's length behind or before the snout tip.

In basic fin structure these 28 specimens agree with most other Atherinidae, as recently described (Hubbs, 1944a). The first dorsal fin comprises a cluster of short, flexible spines, well separated from the second dorsal, which, as also the anal, has one short spine, a single unbranched soft-ray and then a series of branched rays. The caudal has consistently 9+8=17

TABLE 1.—FIN-RAY COUNTS IN MELANORHINUS MICROPS

Specimens	Author	Spines in first dorsal fin			
		5	6	7	8
Atherina microps types	Poey	X	—	—	—
Melanorhinus boekei types	Metzelaar	—	X	—	—
Mugilops marinus type	Meek and Hildebrand	—	—	1	—
Mugilops marinus type	Recount	—	—	1	—
U.S.N.M. no. 9432	Original	—	9	15	4

Specimens	Author	Dorsal soft-rays					
		14	15	16	17	18	19
Atherina microps types	Poey	—	X	—	—	—	—
Melanorhinus boekei types	Metzelaar*	—	—	X	—	—	—
Mugilops marinus type	Meek and Hildebrand	—	—	1	—	—	—
Mugilops marinus type	Recount	—	—	1	—	—	—
U.S.N.M. no. 9432	Original	2	7	6	10	1	2

Specimens	Author	Anal soft-rays						
		19	20	21	22	23	24	25
Atherina microps types	Poey	X	—	—	—	—	—	—
Melanorhinus boekei types	Metzelaar	—	—	—	X	—	—	—
Mugilops marinus type	Meek and Hildebrand	—	1	—	—	—	—	—
Mugilops marinus type	Recount	—	—	—	1	—	—	—
U.S.N.M. no. 9432	Original	—	5	4	11	5	2	1

principal soft-rays. The pelvic comprises a flexible spine and 5 soft-rays. In the pointed pectoral fin the uppermost ray is very short, the second long but unbranched, and the others branched.

In the National Museum we located seven specimens (no. 37530) labeled "*Atherina microps*? Cuba, 1885, Prof. F. Poey." These, however, are obviously not the cotypes of *A. microps*. In fact, they do not represent the same species. They are largely disintegrated but some retain enough flesh and skin over the posterior sides to show a definite silvery band. Two complete vertebral columns respectively comprise 43 and 44 vertebrae, whereas one of the specimens of *M. microps* in the series of 28 has only 39 vertebrae. Search through the disarticulated bones yields premaxillaries with extroverted dentition, mandibles with elevated rami, and opercles that are quite unlike those of *M. microps* (in *Melanorhinus* the opercle is extremely high and short and the articulating socket is much closer to the upper edge than to the lower). The jaw bones clinch the identification of this series as "*Atherina*" *araea* (we use the binomial, since, on the basis of a higher gill-raker count and other characters, the Bermuda form, *harringtonensis*, seems to be specifically distinct). Scales on the specimens as well as loose ones in the jar are also like those of *A. araea* and in one trenchant feature contrast with the scales of *Melanorhinus microps* and *M. cyanellus*. The exposed field is wholly smooth, whereas this part of the scale in *Melanorhinus* is consistently crossed by many very fine, closely set, almost strictly vertical circuli. In *Melanorhinus*, as in the American Atherininae, in contrast to nearly all Atherinopsinae, the lateral scales are very deep, much higher than long; they have few, almost straight and vertical circuli on the basal field, and they have evenly rounded posterolateral angles and no radii.

Melanorhinus occupies a very isolated position in the family but apparently should be retained in the Atherinopsinae. In the compression of the body, particularly of the belly, in the truncated head, and in the very high pectoral fins this genus is approached by *Eurystole* and *Nectarges* (Myers and Wade, 1942). *Melanorhinus* in turn approaches the most bizarre member of the group, *Notocheirus hubbsi* Clark (1937, pp. 88–90, 1 fig.). All these fishes have characters that appear to be adaptations to surface life in or near the surf. They, and particularly *Melanorhinus*, are close coun-

terparts of the species of the Indo-Pacific genus *Iso*, which, presumably, are of like habits. Furthermore, *Melanorhinus* also matches closely the surface-schooling querimana stage of *Mugil*. The resemblance to the querimanas extends even to the scale structure, which undergoes an abrupt and profound change when the querimana postlarva metamorphoses into the juvenile mullet (Jacot, 1920). In the querimana, as in *Melanorhinus*, the circuli of the apical field are numerous, close-set, and vertical. In each genus this structure appears to enhance the silvery sheen of the scale. *Melanorhinus* and other atherinopsine genera named above appear to have had an origin separate from that of *Iso*, as also, certainly, from that of *Mugil*. The kinships involved seem to be most effectively expressed by referring *Iso* to the Atherininae and by retaining the convergent American genera in the Atherinopsinae. To follow Myers and Wade (1942, p. 140) in separating off a monotypic subfamily Melanorhininae would rather befog the apparent relationships.

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